The effects of implementing environmental activities on the sustainable performance of Australian logistics companies

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DECLARATION OF ORIGINALITY

This thesis contains no material which has been accepted for a degree or diploma by the university of any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of the candidate's knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the thesis.

Sonia Sadeghian Esfahani, 9th July 2019

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STATEMENT OF ETHICAL CONDUCT

The research associated with this thesis abides by National Statement on Ethical Conduct in Human Research of Australia and is approved by the Social Sciences and Human Research Ethics Committee of the University of Tasmania with Ethics Reference number (Ref: H0017020).

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ABSTRACT

Logistics is one of the significant sectors that impact on the environment such as air emissions and noises. Consequently, the logistics industry has the potential to decrease negative impacts on the environment with the adoption of environmental-related activities. Despite the increasing awareness about sustainability, the pressure from governments worldwide for environmental adoption and the recognition of the benefits of implementing environmental activities, this area has not been widely researched in relation to Australian logistics companies. Therefore, this thesis empirically investigates the effects of implementing environmental activities on improving sustainable performance as well as the factors influencing environmental adoption.

A literature review is undertaken to identify the environmental-related activities within a logistics scope and the measures of sustainable performance as well as the factors influencing environmental adoption to develop the conceptual framework of this study. Empirically investigating the conceptual framework addresses the primary research question which investigates the effects of implementing environmental activities on improving sustainable performance. Secondly, it addresses the first secondary research question which investigates and ranks the factors having a greater influence on logistics companies towards adopting environmental activities. Thirdly, the conceptual framework is empirically tested to address the second and third secondary questions which rank the measures of sustainable performance from the perspective of Australian logistics managers, and finally, prioritises the implementation of environmental activities in logistics companies based on the preferences of managers. Random sampling is used to determine a sample of 297 senior managers of Australian

logistics companies who are invited to participate in a quantitative web-based survey. A response rate of 21% (61 valid responses) was achieved that included logistics managers whose companies offer a wide range of logistics services. The survey was conducted to find which environmental activities have more effect on improving sustainable performance and those that are less effective. This study also focuses on the measures of sustainable performance and the dimensions that are more preferred by Australian logistics managers. These preferences were used as an approach to find the most beneficial and preferred environmental activities to implement from the perspective of logistics managers. Moreover, the environmental activities were ranked in this study by considering their effects on improving each dimension of sustainability separately (including economic, environmental and social), both dimensions of sustainability (such as economic and social together) simultaneously as well as three dimensions of sustainability. The factors influencing environmental adoption are investigated to find the most and the least effective factors. Improving sustainable performance, which can provide a competitive advantage, and acts as an influencing factor towards environmental adoption. To determine the level of environmental adoption in the Australian logistics industry, the most and the least implemented environmental activities in the last five years were investigated.

This study has both academic and practitioner contributions. At the conceptual level, this study contributes to the literature on logistics and sustainability by developing the conceptual framework with a focus on the logistics industry to cover the gap of the literature in terms of little attention on this sector. This conceptual framework expands the performance and competitive advantage views in the context of environmental adoption by considering and analysing the link among them. In addition, the study contributes to the literature by identifying new drivers and barriers towards environmental adoption as well as new environmental activities which are mentioned by respondents. This study evaluates the most important factors influencing environmental adoption that have not been previously considered in the Australian logistics industry by similar studies. It appears to be the first study conducted to rank the measures of sustainable performance because it reveals which improvements in specific measures have more importance from the view of managers. Moreover, the environmental activities in logistics are prioritised for the first time in this study based on their potential to improve the most important measures of sustainable performance. There is a research gap in the literature in terms of finding the ways of improving the level of environmental adoption. This study finds a way to increase environmental adoption by examining and finding the positive relationship between environmental adoption and improving sustainable performance which can act as a means of achieving a competitive advantage. Determining the level of environmental adoption and finding the most and the least implemented environmental activities in Australian logistics also may extend the context of environmental adoption in logistics.

At the practitioner level, the results provide logistics managers with an insight on the importance and benefits of each environmental activity in terms of improvement in economic, environmental, social and sustainable performance and show how these activities could be preferred to implement based on the company's objective for improvement. These empirical findings help managers to benchmark their business in terms of their level of environmental adoption and determine the opportunity to achieve a competitive advantage by improving their sustainable performance and implementing environmental activities.

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LIST OF ABBREVIATIONS

1PLs	First Party Logistics providers
2PLs	Second Party Logistics providers
3Pls	Third Party Logistics providers
4PLs	Fourth Party Logistics providers
5PLs	Fifth Party Logistics providers
AFIF	Australian Federation of International Forwarders
AHP	Analytical Hierarchy Process
ALC	Australian Logistics Council
AMC	Australian Maritime College
ANOVA	Analysis of Variance
CBV	Capability Based View
CDP	Carbon Disclosure Project
CEO	Chief Executive Officer
CO_2	Carbon dioxide
CSCMP	Council of Supply Chain Management Professionals
DCV	Dynamic Capabilities View
EBITDA	Earnings Before Interest, Taxes, Depreciation, and Amortisation
EFA	Exploratory Factor Analysis
ESCD	Environmental Supply Chain Dynamics
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IT	Information Technology
LEED	Leadership in Energy and Environmental Design
LLPs	Lead Logistics Providers
MBV	Market Based View
NDIS	National Disability Insurance Scheme

OECD	Organisation for Economic Co-operation and Development
PCA	Principal Component Analysis
PRQ	Primary Research Question
R&D	Research and Development
RBV	Resource Based View
SCP	Structure-Conduct-Performance
SRQ	Secondary Research Question
UN	United Nations
UTAS	University of Tasmania
WCED	World Commission on Environment and Development

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CHAPTER ONE: INTRODUCTION

1.1 Background to the study

In the modern trade world, companies are interested in determining how to survive in uncertain conditions and achieve profitability. One of the ways of increasing profitability is gaining a competitive advantage which can stem from resources, competencies and capabilities within the company (Raj & Srivastava 2016; Tornikoski, Rannikko & Heimonen 2017; Hill & Jones 2012). Although many companies have access to relatively similar resources, the bundling of these resources can keep some companies ahead of others. A competitive advantage acts as an obstacle to the entry of competitors into the market (Nadarajah & Latifah Syed Abdul Kadir 2014; Yadav, Han & Kim 2017), although a strategic competitive advantage can be eroded rapidly in a dynamic business environment (Pateman 2015).

Superior performance is one of the means to achieve and remain a competitive advantage (Delery & Roumpi 2017; Porter 2011; Anwar, Khan & Khan 2018) which is of interest in this research study. In addition, restructuring a business based on a new orientation to the market can make a business successful. Recently, the environmental orientation in supply chain management, is a new orientation and a pivotal element which may affect companies' activities and can change the future of business (Suryanto, Haseeb & Hartani 2018; Hong et al. 2012). Therefore, restructuring a business to be environmentally conscious is one approach that can help companies meet the needs of high awareness customers in the new marketplace.

Indeed, customer awareness about environmental issues can influence companies to adopt environmental activities to increase demand (Isaksson 2012; Seroka-Stolka 2014). Furthermore, increasing concern about environmental issues has resulted in pressures on companies from the government and stakeholders to enhance their environmental performance (Lin & Ho 2011; Lorentz et al. 2011; Isaksson 2012). In this regard, international policies and regulations, such as ISO 14000, can help companies to restructure their businesses and implement an environmental management system. Therefore, improving sustainable performance can act as a means of competitive advantage in the modern market for companies that desire to survive through superior performance and implementing environmental activities.

There is also increased attention on adopting environmentally-friendly regulation between competitors (Sharma et al. 2010). There is pressure on companies, for example, to provide an environmentally conscious product and market relationship with supply chain partners to gain economic growth (Sharma et al. 2010). Although the environmental agreements and activities and international regulations are established with the common objective of protecting the environment, companies show several levels of inclination for engaging in them. Companies may adopt environmental initiatives if researchers can demonstrate a potential link between environmental initiatives and increased competitiveness and improved financial performance (Gómez-Bezares, Przychodzen & Przychodzen 2017; Bowe et al. 2001; Čekanavičius, Bazytė & Dičmonaitė 2014).

1.2 Competitive advantage

Competitive advantage can be important for companies as it can improve profitability greater than the average profitability of other competitors, and this can be sustained if a company can maintain above-average profitability over a number of years (Yadav, Han & Kim 2017; Hill & Jones 2012). Competitive advantage is emphasised and developed by several scholars (Alfalla-Luque, Machuca & Marin-Garcia 2018; Jun & Rowley 2018; Yadav, Han & Kim 2017; Huber, Herrmann & Morgan 2001; Huang, Zhou & Han 2013). Some scholars consider competitive advantage from several perspectives and present various definitions. For instance, differentiation and cost leadership are sources of competitive advantage from a market perspective (Leonidou et al. 2015; Porter 1985) while Prahalad (1990) defines competitive advantage as the core competency of the enterprise (Eckel et al. 2016). Distinctive competencies arise from a company's resources and capabilities, which can provide potential access to markets (Raj & Srivastava 2016; Tornikoski, Rannikko & Heimonen 2017). Companies can identify their customers and increase patronage with their capabilities (Prahalad 1990; Eckel et al. 2016). Other scholars such as Hill and Jones (2012) consider competitive advantage through a customer lens and claim that it arises from superior value creation. Similarly, Woodruff (1997) and Pulles et al. (2016) introduce customer value and satisfaction as being the essence of competitive advantage. Thus, scholars have been introducing a range of means of gaining a competitive advantage.

Although perceiving or seeking new ways for competition in an industry and bringing new competitive approaches to market are ways of creating competitive advantage for companies, there are some challenges that make it difficult. The nature of competitive advantage is not constant in the dynamic business environment. A number of factors can shift a competitive advantage and may even erode it rapidly. New technologies, changes in the customers' needs, the emergence of a new industry segment, shifting costs or availability of input, and change in government regulations are some examples of these factors. Since profitability is positively related to meeting the needs of customers (Jun & Rowley 2018; Helgesen 2006; Pulles et al. 2016), companies need to restructure their strategies to adapt to customers' needs. Therefore, environmental adoption in the modern market can be an appropriate strategy to adapt to the needs of the modern market.

Businesses look for a range of means of gaining a competitive advantage to improve profitability. For instance, some businesses use customer value-oriented management (Huber, Herrmann & Morgan 2001; Eggert et al. 2018) because it increases customer satisfaction (Müller 1991). Human resource management is another means employed (Delery & Roumpi 2017, Barney, & Wright 1998; Noe et al. 2006; Amarakoon, Weerawardena & Verreynne 2018). Others use a resource-based view, market-based assets and marketing (Srivastava, Fahey & Christensen 2001; Hitt, Carnes & Xu 2016). It can also be achieved through creating superior performance (Anwar, Khan & Khan 2018; Porter 2011; Saeidi et al. 2015; Delery & Roumpi 2017). Environmental investment is another means of gaining a competitive advantage in the global market (Bonifant, Arnold & Long 1995; Lin & Tsai 2016) because emerging environmental debates are influential. Therefore, environmental adoption is not only a means of creating a competitive advantage, but it may also have the potential to create a competitive advantage through improving sustainable performance.

1.3 Sustainable performance

Similar to most business operations, sustainable performance seeks to achieve specific sustainable objectives (Alfalla-Luque, Machuca & Marin-Garcia 2018; Beske-Janssen, Johnson & Schaltegger 2015). Since merely considering conventional economic performance and assessing it is not sufficient after emerging sustainable development debates (Craggs 2013; Gómez-Bezares, Przychodzen & Przychodzen 2017; Mamat et al. 2015; Beske-Janssen, Johnson & Schaltegger 2015), instead it is preferred to investigate the sustainable performance to cope with the new changes. The first step to assess sustainable performance is identifying the most appropriate measures (Mamat et al. 2015; Ahi & Searcy 2015). Although there are several measures indicated by scholars in this regard, some measures are used more than 20 times in research (Ahi & Searcy 2015) such as energy use and air emission. Environmental and social goals need to be quantifiable as well as economic goals which prove to be a challenging task (Gold, Seuring & Beske 2010) because sustainability strategies rely on all three aspects (Gomez-Bezares, Przychodzen & Przychodzen 2017; Beske-Janssen, Johnson & Schaltegger 2015). Therefore, considering appropriate measures of sustainable performance in each dimension of sustainability can help scholars to investigate sustainable performance before and after implementing strategies such as environmental adoption.

1.4 Environmental adoption

After the business environment changed during the 1990s, some previously successful companies failed to survive in the more competitive global market due to refusing to adopt change (Coyle et al. 2016). There are many major external forces such as technology; globalisation; empowered customers; government policy and security;

organisational consolidation, energy and sustainability (Coyle et al. 2016) that can impact global markets. These forces also affect supply chain management due to their impacts on global markets and nations.

The objectives of managing the traditional supply chain are often reducing costs and improving services with little concern for the environment (Dubey et al. 2017). The philosophy of environmental supply chain management integrates the environmental dimension with the traditional supply chain network (Suryanto, Haseeb & Hartani 2018). The environmental supply chain manages procurement, logistics, manufacturing, distribution and disposal or reuse/recycling by integrating environmental activities (Dubey et al. 2017). Environmental activities not only decrease negative impacts on the environment but also have benefits for the companies that adopt these activities.

Companies may adopt environmental activities for several reasons. Firstly, environmental activities are subsets of corporate social responsibility which plays a significant role in today’s business (Suryanto, Haseeb & Hartani 2018; Baughn & McIntosh 2007; Babiak & Trendafilova 2011). Another reason is that government environmental regulations encourage companies to innovate (Eiadat et al. 2008; Hojnik & Ruzzier 2016). The consequence of innovation can be performance improvement in business functions (Eiadat et al. 2008). Therefore, acceptance of these regulations and standards has advantages for companies. For instance, increasing competitiveness, enhanced reputation and achieving competitive advantage are some benefits of environmental adoption (Porter & Linde 1995; Tan et al. 2015). Companies invest in environmental adoption at several levels because they pursue different objectives. Some companies only limit their environmental adoption to initiatives while others go beyond the regulations and initiatives to be a market leader through proactive sustainable performance.

There are several views on environmental investment by a company. A proposed phenomenological relationship model by Wagner and Schaltegger (2003) cited in Tan et al. (2015, p. 274) depicts that environmental activities could decrease economic success from a traditionalist perspective. The traditionalists argue that environmental regulations burden companies with additional costs (Fullerton & Muehlegger 2017). Conversely, the revisionist view claims that environmental activities could benefit a company's economic success as a potential source of competitive advantage through improvement in economic performance (Alfalla-Luque, Machuca & Marin-Garcia 2018; Fullerton & Muehlegger 2017; Jun & Rowley 2018; Tan et al. 2015). It seems that environmental adoption can benefit companies by means of productivity improvement, processes that are more efficient, lower costs of compliance and new market opportunities that could be attributed to these activities (Alfalla-Luque, Machuca & Marin-Garcia 2018; Kwak, Seo & Mason 2018; Tan et al. 2015).

Companies can improve sustainable performance to enhance profitability and achieve competitive advantage (Koo, Chung & Ryoo 2014; Alfalla-Luque, Machuca & Marin-Garcia 2018; Yadav, Han & Kim 2017) because the relationship between economic and sustainable performance has theoretical logic (Lee 2015). Waste reduction plans, enhancement in human development and risk limitation by adopting better labour activities are examples of environmental activities that improve profitability (Tan et al. 2015). Reduced costs of production, operation and distribution, along with increased distribution efficiency, improved inventory and reverse logistics are examples of the benefits of environmental activity implementation for businesses within a supply chain.

Environmental supply chain management also has a positive impact on the environment (Suryanto, Haseeb & Hartani 2018; Sarkis 2012). For instance, environmental supply chain management can benefit the environment in several ways, such as improvement in energy reduction, waste and pollution reduction, decrease in environmental greenhouse gas, less packaging and water conservation (Sarkis 2012). To have an environmental supply chain, it is necessary to implement environmental activities (Craggs 2013; Dubey et al. 2017).

1.5 Environmental activities

The importance of environmental activity implementation is that companies cannot enhance environmental performance devoid of coordinated activity, even if a company's ecological response is consistent with government policy (Craggs 2013; Suryanto, Haseeb & Hartani 2018; Szegedi, Gabriel & Papp 2017). A number of different factors such as customers, government and regulation influence implementation positively. These are named as drivers or influencing factors which can be internal or external (Ahani, Rahim & Nilashi 2017). There are several influencing factors suggested by scholars in the literature. As an illustration, organisational encouragement, employees' interests (Ahani, Rahim & Nilashi 2017; Chien & Shih 2007) and managerial attitudes and knowledge (Seroka-Stolka 2014; Ahani, Rahim & Nilashi 2017) are examples of internal influencing factors while government pressure and support (Isaksson 2012; Lorentz et al. 2011), customer pressure (Ahani, Rahim & Nilashi 2017; Foster, Sampson & Dunn 2000) and the pressure of future expectation (Isaksson 2012) are examples of external factors. The factors influencing environmental adoption may have various levels of impact on companies and thus should be investigated.

To satisfy stakeholders that act as an influencing factor, companies may adopt environmental activities and investment. The environmental activities could be various depending on the type of business. For instance, manufacturing companies can purchase and use environmentally-friendly raw materials as an activity to reduce waste and improve recycling (Rao & Holt 2005; Zhu, Sarkis & Lai 2008; Van Ewijk & Stegemann 2016). Environmental design and environmental processes are also activities related to manufacturing companies (Abdul-Rashid et al. 2017), which can benefit the company, supply chain and the environment by reducing waste and decreasing energy consumption (Abdul-Rashid et al. 2017).

Some companies outsource activities such as packaging, labelling, storage and warehousing, and transportation to logistics companies to save costs and achieve competitive advantage (Wang et al. 2018; König & Spinler 2016). Consequently, logistics companies can offer a wide variety of services to their service buyers with environmental integration. There are many environmental activities in the literature, which are suggested by scholars such as environmental transportation (Lam & Dai 2015), environmental warehousing (Zhang et al. 2014) and environmental packaging and labelling (Čekanavičius, Bazytė & Dičmonaitė 2014) that are within the scope of the logistics industry. Since transportation, inventory management, warehousing, exterior packaging, and material handling are logistics activities in a supply chain

(Coyle et al. 2016), the integration of environmental activities in logistics becomes important because environmental logistics functions play a vital role to make the supply chain environmental-friendly. In addition, environmental activities can benefit logistics companies with several advantages such as cost savings as well as reducing negative impacts on the environment (Laari, Töyli & Ojala 2017; Wang et al. 2018).

1.6 Logistics and supply chain

The role of logistics has become more significant for companies because supply chains are considerably longer, expensive, uncertain and complex (Laari, Töyli & Ojala 2017; König & Spinler 2016). According to Esteves and Barclay (2011), the definition of supply chain management by the Council of Supply Chain Management Professionals (CSCMP, 2011: p.1)" includes the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities". When other companies in the supply chain decide to concentrate on their core competencies, they outsource their logistics activities to logistics service providers (König & Spinler 2016). Thus, the concept of logistics is defined as "that part of supply chain management that plans, implements and controls the efficient and effective forward and reverse flow with the storage of goods, services, and related information between the point of origin and the point of consumption to meet customers' requirements" (Overstreet et al. 2011, p. 116). Consequently, logistics is one of the key areas, which plays a vital role within supply chains (König & Spinler 2016) because logistics companies can benefit other companies to decrease costs and improve profitability (Evangelista, Colicchia & Creazza 2017).

Outsourcing logistics activity to logistics service providers has several benefits. Firstly, it can decrease the inventory and distribution costs for manufacturing companies (Schaltegger et al. 2014). Secondly, outsourcing logistics activities can provide a competitive advantage within supply chains through resource-based theory (Evangelista, Colicchia & Creazza 2017; Poulsen, Ponte & Lister 2016; Srivastava 2007). Finally, outsourcing logistical functions can help the environment due to a reduction in pollution and decrease in other negative effects. For instance, optimisation of transportation by means of logistics companies can decrease fuel consumption and CO2 emissions. Thus, logistics service providers can benefit companies in the supply chain and the environment simultaneously in today's business environment. In this regard, logistics service providers carry out logistical functions for their service buyers in a supply chain.

Logistics service providers' activities are those activities of third party logistics that are carried out on behalf of a shipper (Centobelli, Cerchione & Esposito 2017; Isaksson 2012). These activities comprise at least transportation and can extend to whole services. Moreover, other activities such as warehousing and inventory management, as well as information activities such as tracking, and value-added supply chain activities such as secondary assembly and installation of products, can be integrated into the service offering (Centobelli, Cerchione & Esposito 2017).

Logistics service providers can be divided into third parties, fourth parties and fifth parties as well as cargo owners and carriers. In the early 1970s, the term "3PL" (third party logistics) was first used in transportation contracts for identifying intermodal marketing companies (Lai 2004; Singh, Gunasekaran & Kumar 2017). This type of logistics service provider still has some way to go to meet the expectations of customers. Lead logistics providers termed 4PL and 5PL are companies taking full responsibility for organising the whole transport chain from producer to customers. A 4PL takes the lead on advising or making supply chain decisions while a 5PL takes the lead in a network (Lai 2004; Singh, Gunasekaran & Kumar 2017). Since the activities of third party logistics are physical with potential negative impacts on the environment, environmental management of the logistics service providers deserves special attention.

Environmental management of logistics service providers is related to internal efficiency, competitiveness and compliance (Centobelli, Cerchione & Esposito 2017; Maack 2012). Environmental management largely seems to be only of implicit interest for competitiveness at present and of more concern to future competitiveness (Maack 2012). Recently, a great deal of addressing customers' environmental demands entails proof by logistics service providers to their customers of their environmental efforts, regardless of what it actually entails. The logistics service providers' capabilities are vital to cope with change regarding increased environmental demands.

Logistical activities frequently have the greatest negative impacts on the environment within a supply chain. Thus, research on environmental logistics issues has attracted a great deal of academic attention in recent years due to the growing public consciousness of global warming (Abduaziz et al. 2015). A supply chain with an environmental orientation is considered a strategically intangible capability (Chan et al. 2012). Thus, adopting environmental activities can benefit managers as intangible capabilities to create advantage for companies and make the companies successful in competitiveness (Hall 1993; Eloranta & Turunen 2015). Furthermore, an environmental supply chain is a strategic capability which could be exploited by logistics companies (Nadarajah & Latifah Syed Abdul Kadir 2014). Since a higher improvement in performance is a means of achieving a competitive advantage, implementing environmental activities may provide companies with a competitive advantage through improving sustainable performance. Therefore, this study investigates the effects of implementing these activities on improving sustainable performance which may create a competitive advantage for logistics companies.

1.7 Research questions and objectives

Although some scholars claim environmental initiatives can improve sustainable performance (Song et al. 2018; Suryanto, Haseeb & Hartani 2018; Isaksson 2012; Rao and Holt 2005), there is a lack of empirical research on investigating the effects of environmental adoption on improving sustainable performance in logistics. Thus, this thesis investigates the effects of environmental activity implementation on sustainable performance for Australian logistics companies. The Primary Research Question (PRQ) for this study is:

PRQ: Does adoption of environmental activities improve sustainable performance for logistics companies?

To investigate the PRQ, three Secondary Research Questions (SRQs) have been developed. The academic literature points to factors influencing environmental activity implementation, but this thesis investigates the levels of impact of each influencing factor on the adoption of environmental activities for logistics companies. This research study ranks these influencing factors based on their levels of impact on

Australian logistics companies with respect to adopting environmental activities. Thus, the first SRQ is:

> **SRQ1:** Which factors have a greater influence on logistics companies towardadopting environmental activities?

In addition, this thesis investigates the most common environmental-focused activities in logistics which may improve sustainable performance and the environmental activities which have been undertaken by Australian logistics companies in the last five years to answer the following secondary research question:

> **SRQ2:** Which environmental activities have been undertaken by Australian logistics companies in the last five years?

This thesis investigates what environmental activities may have a greater influence on improving sustainable performance. In other words, what environmental activities may have the most potential to improve sustainable performance. Thereby, the third SRQ for this study is:

> **SRQ3:** Which environmental activities have a greater influence on improving sustainable performance for logistics companies?

To find the most influential environmental activities, this research will rank the measures of sustainable performance because the improvement in some measures may have more importance when compared with others and some managers may prefer to improve the most important measures of sustainable performance.

Investigating these issues in the Australian logistics industry may provide information to both academics and industry. The results of this study may show the most important influencing factor of environmental implementation for logistics companies and the rank of these influencing factors based on their strength. In addition, environmental activities are ranked based on their effects on improving sustainable performance. This study may benefit managers by improving the level of environmental adoption in their companies because they can recognise which activities have the most positive effect on improving sustainable performance. In addition, the results of this study may provide logistics managers with information about the most influential environmental activities for improving each dimension of sustainability as well as each measure of sustainable performance.

1.8 Significance of the research

In the last decade, many companies have adopted environmental activities to improve their performance (Song et al. 2018; Suryanto, Haseeb & Hartani 2018), which benefits them by improving their competitive edge in the global market (Dubey et al. 2017). Consequently, there is a theoretical link that exists between environmental activities and sustainable performance (Gómez-Bezares, Przychodzen & Przychodzen 2017; Gardas & Narkhede 2013; Schrettle et al. 2014). Since researchers frequently investigate the effect of environmental activities on the economic performance of a company and the economic outcome of a strategy might not be always visible (Golicic & Smith 2013), empirically investigating the relationship between environmental activity implementation and improving sustainable performance could be significant. When sales, profit, and ROI are increased, measuring the impact of the environmentally friendly projects on it and recognising the exact amount related to environmental investment is vague (Ahi & Searcy 2015; Gunasekaran, Patel & Tirtiroglu 2001). For example, isolating the effects of every project is required to measure the ROI of each environmentally-friendly project, especially, when the recognition is about effects of training and converting data to monetary value through the use of complex techniques is needed (Ahi & Searcy 2015; Philips 2012). Although some scholars cover some aspects of sustainable supply chain, there are still some opportunities to investigate environmental and social aspects in more depth (Lu et al. 2018).

So far, most of the research on environmental issues have concentrated on the manufacturing sectors. Thus, it seems that little attention is paid to the service sector to which logistics companies belong (Evangelista, Colicchia & Creazza 2017; Lin & Ho 2011). In addition, although transportation is a vital part of supply chain management and is the main source of emissions and a serious threat to the environment, there are limited studies related to this issue (Evangelista, Colicchia & Creazza 2017; Trivedi 2016). According to Isaksson (2012), even though logistics service providers have more awareness about environmental issues, the development of the literature of environmental initiatives in this area is in its infancy. Hence, there is limited literature about logistics service providers and environmental issues in spite of logistics' significant role within an environmental supply chain. Moreover, there is a research gap in finding ways of improving the level of adoption of environmental activities in logistics service providers to meet the requirements of environmental supply chains (Lam & Dai 2015).

Based on the gaps, this research seeks the effects of the environmental activity adoption on three dimensions of sustainable performance (economic, environmental and social). For greater clarification, this research investigates the effects of implementing environmental activities in logistics on improving the measures of sustainable performance. This research study may contribute widely to a deeper understanding of sustainable performance and environmental activities.

Identifying the level of adoption of environmental activity and interpreting the collected data are other research gaps (Schaltegger et al. 2014). Hence, another potential contribution of the thesis is determining the level of environmental adoption in the Australian logistics industry and finding which environmental activity in the logistics industry can help a logistics company to improve its performance in each dimension of sustainability based on the company's objective. Identifying the level of environmental adoption in terms of the most and the least implemented environmental activities can suggest which companies lag behind and which companies are leaders in the market. Moreover, this research will conduct a pairwise comparison among the dimensions and measures of sustainable performance to quantify their importance weight and identify the most and the least important dimensions of sustainable performance and their measures from logistics managers' viewpoints. Furthermore, this research study will rank environmental activities based on their effect on improving sustainable performance and identify the most and the least influential environmental activities in logistics which may provide a company with advantages.

1.9 Structure of the thesis

The thesis investigates the effects of environmental implementation on improving sustainable performance for Australian logistics companies. The thesis consists of seven chapters. This chapter introduces the research background, significance and research questions. Chapter 2 includes the literature review on the antecedents of competitiveness, performance improvement as a means of gaining a competitive advantage, sustainable performance and measures of sustainable performance. The third chapter discusses the influencing factors on environmental implementation, definitions of environmental activity in general, specific environmental activities in logistics and the benefits of environmental adoption. The fourth chapter discusses the research methodology used to investigate the research questions. The fifth and sixth chapters consist of details of data analysis and relevant findings of this research as well as discussion. Chapter 5 addresses demographic questions as well as SRQ1 and SRQ2 while Chapter 6 answers SRQ3 and PRQ. In conclusion, Chapter 7 summarises the research findings that answer the research questions, outlines the research limitations, discusses implications and highlights future research.

CHAPTER TWO: COMPETITIVE ADVANTAGE IN LOGISTICS

2.1 Introduction

Mature markets put pressure on companies to satisfy their customers with more customised and comprehensive value offerings (Roy et al. 2009). Thus, business sustainability in mature markets is more complex than before. In other words, merely meeting the needs of customers is not sufficient to satisfy customers. Thus, companies need to seek ways of offering products that are more valuable and providing services with consideration for the latent needs of the customer. Having a competitive advantage is also an imperative for companies to remain sustainable in an uncertain and competitive environment. Since business sustainability depends on profitability, managers must try to improve the efficiency and effectiveness of performance to increase profitability (Jogaratnam 2017). Therefore, managers need to identify the competitive factors in the market, the correct utilisation of resources and skills, and match these factors to attain profitability and business sustainability (Delery & Roumpi 2017; Raj & Srivastava 2016; Hill & Jones 2012). In planning for success and being competitive in the market, strategic management plays a critical role. In addition, strategic management can be a useful tool for managers to identify and bundle their resources based on the market positions and customers' needs (Hill & Jones 2012). Logistics industry is competitive because it plays a vital role within supply chains. This chapter, firstly, explains several views to competitive advantage, definitions of competitive advantage and strategies for creating and gaining competitive advantage. This chapter explores how various companies apply competitive concepts and then explains that these notions of competitive advantage will be applied to logistics. This chapter discusses about improving sustainable performance to gaining a competitive advantage. Since this study focuses on logistics companies, sustainable performance and its measures are discussed in logistics.

2.2 Views of competitive advantage

The central theme of the academic field of strategic management is arguably the pursuit of competitive advantage (Trigeorgis & Reuer 2017; Furrer 2008). According to Eloranta and Turunen (2015), there are four distinct strategic views to competitive advantage, including the competitive market force, resource-based view (RBV), dynamic capabilities view and the relational view. In addition, according to Wang (2014), the notion of transient advantage is an even more recent proposal by McGrath (2013). The literature suggests that views of competitive advantage started to formulate from the 1960s until mid-2013. The market-based view (MBV) and RBV are two dominant views of competitive advantage that emerged in the early period in 1968 and 1991 respectively. The MBV concentrates on the company's environment and external factors while the RBV of strategy is founded on the notion of core competencies. Capability-based and knowledge-based views of strategy stem from the RBV around two decades later (Yadav, Han & Kim 2017). The resource-based, dynamic capability-based and knowledge-based views only concentrate on creating a competitive advantage with resources of one company devoid of attention to the partners' contribution while the assumptions of those views are critiqued by a relational view (Wang 2014).

The relational view of strategy by Dyer and Singh (1998) is a more recent formulation, which has received considerable attention. ‘A supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners’ (Dyer & Singh 1998, p.674). The relational view states that competitive advantage can only be an industry achievement of the idiosyncratic contribution of specific alliance partners and the service ecosystem (Eloranta & Turunen 2015; Lavie 2006; Porter 2008). Dyer and Singh (1998) have offered a relational view of competitive advantage that focuses on dyad/network routines and processes as an important unit of analysis for understanding competitive advantage. A company’s critical resources may extend beyond company boundaries. Inter-firm linkages may be a source of relational rents and competitive advantage (Carter, Kosmol & Kaufmann 2017; Dyer & Singh 1998).

The relational view points to a company's critical resources that may extend company boundaries and be embedded in inter-company resources and routines (Carter, Kosmol & Kaufmann 2017). The relational view is a theoretical lens to examine and explore value-creating linkages between companies. Relationships between two or more companies both in the micro-level and macro-level contexts are considered in an inter-organisational network (Carter, Kosmol & Kaufmann 2017; Wang 2014). Since the global market is dynamic, companies need to adapt strategies with changes. Thus, strategies with shorter lifecycles may overcome this issue. The notion of the next view is a need to have shorter cycle strategies.

A recent proposal by McGrath (2013) is a transient advantage view that made a significant case to overturn traditional assumptions about the temporal scope of the strategy formulation and execution processes (Bashir & Verma 2017; Wang 2014). Traditionally, managers formulate strategies to guide the company's behaviour for prolonged periods while the transient advantage view claims that opportunities for leveraging competitive advantage are transient in the evolved environment of business. Thus, strategies need to revise faster with much shorter life cycles for fast reaction to changing market conditions. This view is arguably most relevant to the market-based view because of a need to respond much faster to market changes (Bashir & Verma 2017). Since business networks are also increasingly becoming transient, with virtual enterprises forming and disbanding with great rapidity, the transient advantage view can be also aligned with the relational view.

Although the transient advantage view is the most recent approach, there are some challenges that make use of it difficult. For example, resources and internal capabilities of a company have not sufficient dynamism to cope with transience while the transient advantage view focuses on restructure strategies faster in a shorter life cycle. The relational view of strategy is appropriate for business networks with virtual enterprises when collaborating partners attempt to create a competitive advantage through value-creating linkages between companies (Carter, Kosmol & Kaufmann 2017; Wang 2014). Thus, the relational view is not appropriate when a single company attempts to achieve a competitive advantage through its own capabilities and resources. Since the current study focuses on achieving a competitive advantage for a single company, other views to competitive advantage with a focus on a single company will be further elaborated in this chapter. In chronological order, the first view developed is the MBV that considers competitive advantage at an industry level.

2.2.1 Market Based View (MBV)

The MBV of strategy by Bain (1968) argues that the primary determinants of company performance are industry factors and external market orientation (Peteraf & Bergen 2003). A company's unique set of activities that are different from its competitors is the strategic position of the company. From this lens, the structure and competitive dynamics of the industry within which it operates solely determine a company's profitability or performance (Wang 2014). Scholars such as Bain (1968) argue that the performance of a company significantly depends on the industry environment. The MBV considers the position of the company in the market relative to its competitors and in the context of the industry as a whole (Wang 2014). The Structure-Conduct-Performance (SCP) framework by Bain (1968) and Porter's (1980) five forces model that is based on the SCP framework are in this category to restructure activities of a company based on the market and industry environment.

The competitive market forces model helps managers with valuable information on three aspects of corporate planning (Wu, Tseng & Chiu 2012; Mandal 2011). Firstly, this model supports decisions about entry or exit from an industry or a market segment because statistical analysis of this model can determine the attractiveness of the industry and provide insight into profitability. In addition, this model compares the effect of competitive forces on a company with competitors. Secondly, dynamic analysis of this model reveals insights about the potential future attractiveness of the industry to determine potential changes in competitive forces. Finally, companies can develop options to affect the power and intensity of competitive forces with knowledge about them to enhance their own competitive positions (Wu, Tseng & Chiu 2012; Mandal 2011).

However, the five forces model of Porter (1985) has disadvantages. This model shows only a snapshot of the environment that can change quickly. Moreover, this model is more applicable for analysis of a simple market structure while today's market is more complex. The market structure is considered relatively static in this model and non-market forces are not considered (Wu, Tseng & Chiu 2012; Mandal 2011). Since this model is a static model, it is not sufficient to show the dynamism of the global market. Thus, a non-static model such as a transient advantage view can cover its weaknesses about being static.

2.2.2 Resource Based View (RBV)

Six years after the proposal of the competitive market forces model by Porter (1985), the RBV (Barney 1991) argued that the key to superior performance is converting the company's resources (tangible or intangible assets) and capabilities into a sustainable competitive advantage (Jogaratnam 2017; Liu et al. 2010). From the 1980s onwards, the RBV of strategy has emerged as a popular theory of competitive advantage with a focus on internal resources of a company instead of the structure of the industry (Delery & Roumpi 2017; Yadav, Han & Kim 2017; Furrer et al. 2008). The importance of this view is that a company's competitive advantage emerges when duplicating resources and capabilities is difficult for its competitors. Barney (1991) suggests that companies can achieve competitive advantages through the accumulation of strategic assets that are rare, valuable, hard to imitate and substitute to make obstacles for any potential or current rivals (Jogaratnam 2017).

The resources of a company comprise all tangible or intangible assets, capabilities, organisational processes, company attributes and information knowledge. Differences between companies stem from resource bundling and their capabilities (Jogaratnam 2017; Barney 1991). Companies use strategies to enhance their efficiency and effectiveness of performance to increase profitability. In addition, a competitive advantage increases superior profitability (Hill & Jones 2012). A competitive advantage is a result of strategies shaping what occurred with the competencies of the company. In turn, the competencies of the company stem from capabilities and resources built by strategies (Delery & Roumpi 2017; Raj & Srivastava 2016; Hill & Jones 2012). The RBV is the most appropriate when managers want to understand why competencies can act as a company's most important asset as well as to appreciate how those assets can be used to enhance business performance (Delery & Roumpi 2017). The RBV argues that attributes of a company related to experiences, organisational culture and competencies are critical for the success of the company (Jogaratnam 2017). According to RBV, companies need to identify their competencies and capabilities and use them to create value for customers as well as attempt to improve performance to achieve a competitive advantage.

Core competencies are the engines that develop the core products/services of innovative value that attract customers because core competencies are company's ability to compete and develop their core products in the long term (Ghasemaghaei, Ebrahimi & Hassanein 2018; Yang 2015). Core competencies act as a driver for a company’s growth by using a knowledge-based view (Yang 2015). In addition, core competencies are the integration of specialised and technological knowledge and skills that make a company distinguishable from competitors (Ren et al. 2017; Long and Vickers-Koch 1995). Utilising competencies in the development of a strategy process to offer innovative valuable products/services to the customer is an ability of a company that is referred to as a core capability (Yang 2015).

Competencies refer to the skills, knowledge, and technological know-how that provide a special advantage at specific points of the value chain. Core capabilities are formed by competencies when competencies are linked together with strategic processes (Ghasemaghaei, Ebrahimi & Hassanein 2018; Vickers-Koch 1995). In other words, a company’s capabilities are determined by how it can use its skills to add value to its assets (Yang 2015). Core capabilities can increase value for customers and stakeholders. For example, companies can implement research and development (R&D) activities effectively as a core capability of intensive knowledge which can also be a critical determinant of competitive advantage. Since core capabilities are able to contribute value to customers, core capabilities can be a fundamental force for entrance to new markets (Ren et al. 2017; Almer & Hashai 2004; Kaplan & Norton 2004; Hamel &Prahalad 1992).

2.2.3 Capability Based View (CBV)

Grant (1991), Jun and Rowley (2018), and Raj and Srivastava (2016) argue that resources are the source of capabilities which act as a source of competitive advantage. Some scholars such as Amit and Shoemaker (1993) argue that the capabilities of a company contribute to sustained competitive advantages while resources do not. An ability to apply capabilities to perform important activities within a company can create a competitive advantage (Jun & Rowley 2018; Raj & Srivastava 2016; Haas and Hansen 2005). A capability is a company's capacity to deploy resources, usually in combination using organisational processes including information-based, tangible or intangible processes that are company-specific and developed over time through complex interactions among the company's resources (Amit and Shoemaker 1993). A company's resources and capabilities also need to change over time to cope with changing market conditions because the market is dynamic. To overcome the weakness of the resource-based and capability-based view, Teece, Pisano and Shuen (1997) developed the dynamic capabilities view.

2.2.4 Dynamic Capabilities View (DCV)

Dynamic capabilities by Teece et al. (1997) is defined as 'the company's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments' (Wu 2010, p.28). The DCV argues that to address a rapidly changing environment, a company must use its ability to integrate, develop, and reconfigure internal and external competencies and resources (Alfalla-Luque, Machuca & Marin-Garcia 2018; Teece et al. 1997). When global competitive forces are changing the landscapes of industries, the DCV approach is especially relevant. For example, in this globalised environment, the ways of gaining competitive advantage change quickly (Dubey et al. 2017). Therefore, companies in this marketplace need to have timely strategies, flexible infrastructures, and an ability to utilise resources and capabilities in coupled and innovative ways (Alfalla-Luque, Machuca & Marin-Garcia 2018; Teece et al. 1997). In other words, a competitive advantage is achieved in the dynamic marketplace based on capabilities, which have greater homogeneity and substitutability across companies in contrast to traditional RBV assumptions (Eisenhardt & Martin 2000).

The DCV has an external perspective and considers the boundaries of the company to the external environment (Dubey et al. 2017; Eloranta & Turunen 2015). The ability of a company to adapt, reconfigure, and innovate in changing market conditions can lead to achieving competitive advantages instead of a unique set of resources (Alfalla-Luque, Machuca & Marin-Garcia 2018; Hobday 1998; Roberts 1998). Dynamic capabilities can be a source of sustainable competitive advantage for gaining better performance and a way for companies to develop and manage their dynamic capabilities in response to the environment (Lin & Tsai 2016) based on market orientation. Companies can pursue a competitive advantage by creating better matches between the configuration of their resources and the external environmental conditions (Dubey et al. 2017; Wu 2010, Teece and Pisano 1994). Organisational learning plays a significant role as a dynamic capability. Thus, capabilities and organisational learning are a part of any strategy within a company whether implicitly and explicitly. Since the ability to learn and create new knowledge is crucial to achieve a competitive advantage (Wang 2014), a knowledge-based outlook emerges as another strategic view to competitiveness.

2.2.5 Knowledge Based View (KBV)

The KBV by Teece et al. (1997) argues that knowledge has special characteristics that make it the most important and valuable resource compared with other generic resources considered in the RBV (Mahdi, Nassar & Almsafir 2019). Firstly, knowledge, know-how, intellectual assets and competencies are the main drivers of superior performance in the information age (Mahdi, Nassar & Almsafir 2019; Hamel and Prahalad 1994). Secondly, knowledge is the most important resource of a company that increases with use whilst material resources decrease when used in the company (Evans 2003). Moreover, knowledge is the resource that is difficult to imitate while other sources such as technology, capital or product are easier to copy by rivals (Wang 2014).

Overall, all above mentioned views to competitive advantage are robust theoretical bases for developing the idea of the current study with the exception of relational view. The relational view focuses on creating a competitive advantage through the contribution among companies in a network, while this study investigates the potential of environmental activity implementation for creating a competitive advantage through improving sustainable performance with a focus on a single company. Environmental activity implementation could be considered as a company's resource and capability which is confirmed by RBV and CBV. MBV, DCV, KBV and transient advantage view confirm the necessity of implementing environmental activities to cope with new changes in the market as well as acquiring new knowledge and technologies. Environmental activities could be new tangible and intangible resources and capabilities which can provide a company with a competitive advantage based on the recent changes in the market with an environmental focus.

To determine potential changes in competitive forces, dynamic analysis of a competitive market model helps managers with giving insights about the potential future attractiveness of the industry. Hence, a competitive market force model can be appropriate when a company attempts to create a competitive advantage at the industry level. In addition, having only insights about the potential future attractiveness of the industry is not sufficient for a company to be ahead of rivals. Thus, a company needs to restructure resources and capabilities based on future attractiveness in the industry. Although the use of MBV and RBV simultaneously can be the most appropriate strategy for a single company to achieve a competitive advantage, they are not strong enough in response to transient advantage. Understanding future demands and attractiveness of the industry, and flexibility in restructuring strategies are factors that can cover the weaknesses of those views and help companies cope with transient advantages in the market. Thus, companies need to think differently about strategy with more flexibility for building up transient advantages and seizing and exploiting opportunities.

2.3 Definitions and strategies of competitive advantage

The first definition of competitive advantage was by Ansoff (1965) who defines it as features of the rare opportunities within the fields of product-market and the growth vector (Kwak, Seo & Mason 2018). Ansoff (1965) does not clarify types and the ways of creating competitive advantages. Twenty years later, Porter (1985) states that competitive advantage has two types of strategies including cost leadership and differentiation based on his value chain strategy (Bayraktar et al. 2017). Competitive advantage comes from the value that a company creates for its customers that exceeds the company's cost of creating it (Bayraktar et al. 2017; Porter 1985). The definition of competitive advantage can be classified into two distinct parts including source of determinants and performance (Sigalas & Pekka Economou 2009). Some statements by scholars such as Wiggins and Ruefli (2002) and Bayraktar et al. (2017) in strategic management match competitive advantage with its causes such as resources and capabilities, cost leadership, and differentiation. Others (Li et al. 2017; Palmer & Truong 2017; and Sigalas and Pekka Economou 2013; Grahovac & Miller 2009) match it with its consequences including performance, higher profitability, the benefit-cost gap and above-average return.

Some scholars define competitive advantage in terms of its source of determinants. For instance, Delery & Roumpi (2017) and Powell (2002) states that competitive advantage includes features of location, technology, and products and is different from superior performance such as market share, profit and share price. Thus, competitive advantage not only belongs to a company's performance, but also stems from several features. In other words, competitive advantage is a set of capabilities or resources that offer the company an advantage over its rivals and can lead to higher performance based on the RBV (Wamba et al. 2017; Wiggins and Ruefli 2002).

However, there are several definitions of competitive advantage in terms of performance (Yang 2015). For instance, a company creates value for its customers, but competitive advantage grows fundamentally out of this value (Porter 1985; Sigalas & Pekka Economou 2013). A company with persistent high relative profitability possesses a competitive advantage (Palmer & Truong 2017; Tomas 1986). A competitive advantage can also be defined as providing superior financial performance (Winter 1995). In addition, a competitive advantage can be a cross-sectional difference in the domain between the demand of the product market and marginal cost (Grahovac and Miller 2009). Moreover, competitive advantage can be defined as a reflection of rare and innovative values that customers desire to buy (Bashir & Verma 2017; Dube and Renaghan 1999).

There are several definitions of a competitive advantage. Companies use various ways to improve performance because increased profitability is the result. The way that a company opts to improve performance depends on the company's strategic view to competitive advantage. For example, managers with a MBV, attempt to achieve a competitive advantage through creating value for customers while a company with focus on a RBV chooses restructuring resources to improve performance. It seems that the best result can be achieved when a company uses a combination strategy because restructuring the resource is valuable when it has the potential to satisfy customers. Thus, competitive advantage can be achieved when a company opts for efficient bundling of resources based on market requirements and attempts performance improvement.

2.4 Creating competitive advantage

Porter's definition of competitive advantage (1985) in terms of value and a company's performance could be considered and conceptualised as equivalent to the particular net benefits of the price paid (Sigalas & Pekka Economou 2013). Value is what customers are willing to pay and an offer of lower prices than competitors for equivalent benefits or provision of unique benefits can delight customers (Zhang, Jahromi & Kizildag 2018; Porter 1985). Thus, cost leadership and differentiation are two basic types of competitive advantage (Porter 1985) which create values for customers and provide a competitive advantage for companies. Companies create competitive advantage by perceiving or seeking new ways for competition in an industry that brings them to market, which is ultimately an act of innovation (Sigalas, Pekka Economou & Georgopoulos 2013). For example, product leadership, operational excellence, and customer intimacy are three types of value disciplines that a company can concentrate on gaining competitive advantages (Treacy & Wiersema 1997).

The nature of competitive advantage is not constant because of several factors that affect customer and market orientation in the dynamic business world. Considering Porter's five forces model (1985) and dynamic theory by Teece et al. (1997) sheds light on this claim. For instance, new technologies, changing customers' needs, the emergence of a new industry segment, shifting costs or availability of input, and change in government regulations are examples of factors that impact on a company's competitiveness and further influence its competitive advantages (Coyle et al. 2016; Sigalas & Pekka Economou 2013). Through an internal view of competitive advantage, it can be seen to stem from the way companies perform distinct activities at the level of strategic implementation such as conceiving of new ways to conduct activities, using new procedures, new technologies, or differential inputs (Hill & Jones 2012). To lock out imitators, integrating several strategic activities is vital. To investigate whether a company's competitive advantage has been achieved, valid measures can be useful because they can show what degree of performance is required to gain a competitive advantage.

2.5 Strategies for gaining competitive advantage

Based on different definitions of competitive advantage, there are several means for gaining it. For example, customer value-orientation is a strategy pointed out by Huber, Herrmann and Morgan (2001) and Valenzuela Fernández and Torres Moraga (2017) to achieve a competitive advantage. Since a fundamental means of increasing customer orientation is creating customer value (Valenzuela Fernández & Torres Moraga 2017; Slater & Narver 1998), creating superior customer value is a vital precondition for maintaining security in a competitive environment, not to indicate a leadership position in the market (Day 1990). A company can follow two generic routes to compete in a market: differentiation or low cost to create superior customer value (Porter 1985). ‘Regardless of which of these routes is emphasised, the effort will fail unless significant customer value is created’ (Huber, Herrmann & Morgan 2001, p. 41). The difference between a customer's perceived benefits and customer's perceived costs is defined as being the perceived customer value (Day 1990) which persuades a customer to buy goods or services. Differentiation and/or low cost can create perceived customer value.

Srivastava, Fahey and Christensen (2001) argue that market-based assets and marketing act as a means of achieving competitive advantage. Market-oriented or core business processes use market-based assets and capabilities to deliver superior customer value and competitive advantage which can result in superior corporate performance and shareholder value. Market-based assets and capabilities can create value elements and competitive advantages for investment to nurture market-based assets and capabilities in the future (Srivastava, Fahey & Christensen 2001). Thus, a company can achieve a competitive advantage through restructuring its assets based on market orientation to increase profitability.

Human resource management is another means of gaining a competitive advantage (Amarakoon, Weerawardena & Verreynne 2018; Delery & Roumpi 2017; Elshaer & Augustyn 2016; Noe et al. 2006) because characteristics of human resources such as knowledge, experience, skills, commitment and loyalty of employees and their relationship can be sources of competitive advantage (Bhat & Darzi 2016). Experts and knowlegeable employees with higher knowledge and skills can improve performance. In addition, loyalty and commitment of employees help managers to keep these sources of knowledge in the company. Since innovation can lead to a competitive advantage which stems from knowledge, managing the knowledge and skills of human resources can act as a means to create a competitive advantage. Customer satisfaction is another means of gaining competitive advantage suggested by Bhat and Darzi (2016). Customer satisfaction is valuable due to impacts on customer retention and its relationship (Bhat & Darzi 2016) to maintain and increase the market share (Mishra, Sinha & Koul 2017), leading to profitability (Rust & Zahorik 1993). Creating superior performance leads to a competitive advantage (Delery & Roumpi 2017; Porter 2011). Thus, improved performance helps companies to increase profitability, market share and gain competitive advantage to survive.

Value is what customers receive and what customers are willing to pay. An offer of lower prices than competitors for equivalent benefits or provision of unique benefits can delight customers (Porter 1985). Thus, cost leadership and differentiation are two basic types of competitive advantage (Porter 1985) which create value for customers and provide a competitive advantage for companies. Companies create competitive advantage by perceiving or seeking new ways for competition in an industry that brings them to market, which is ultimately an act of innovation (Sigalas, Pekka Economou & Georgopoulos 2013). For example, product leadership, operational excellence, and customer intimacy are three types of value disciplines that a company can concentrate on gaining competitive advantage (Treacy & Wiersema 1997). Companies in the modern world seek new ways to success and sustainable performance is a new area in the world for competitiveness. Therefore, improving sustainable performance can provide companies with competitive advantages (Sigalas & Pekka Economou 2013).

Since a business sustainability and being successful in the market depend on satisfying customers, companies attempt to adapt to customers' new orientations continuously. Several forces in the past drove this corporate strategy such as production pressures, employee pressures and, more recently information pressures, but in the past decade, environmental issues have also been added to these drivers (Jansson, Nordlund & Westin 2017; Welford 1999). The belief that environmental activities can provide benefits through a reduction in costs and increased market opportunities contributes to major changes in corporate strategy. In addition, the existing sub-theories of corporate strategy (principally competitive advantage and competitive strategy) are being slowly modified to include both environmental problems and concerns and are being broadened to incorporate the principles of sustainable development (Jansson, Nordlund & Westin 2017; Welford 1999).

Leading companies have started to use environmental management as a strategic tool for achieving competitive advantage. Since resources, competencies, and capabilities can restructure to gain competitive advantage through strategies (Tornikoski, Rannikko & Heimonen 2017; Hill & Jones 2012), strategic management with an environmental orientation has the potential to benefit companies to achieve competitive advantage (Papadas, Avlonitis & Carrigan 2017; Isaksson & Huge-Brodin 2013; Salomone 2008). Environmental activity adoption can lead to improve sustainable performance that creates a competitive advantage for companies (Sigalas & Pekka Economou 2013). Hence, achieving a competitive advantage can be an influencing factor toward the adoption of environmental activities which may stem from improving sustainable performance.

2.6 Sustainable performance

Companies perform distinct activities at the level of strategic implementation such as conceiving of new ways to conduct activities, using new procedures, new technologies, or differential inputs to create a competitive advantage (Hill & Jones 2012). To lock out imitators, integrating several strategic activities is vital. To investigate whether competitive advantage has been achieved, measuring competitive advantage by valid measures can be useful because it can show what degree of performance is required to gain a competitive advantage. Porter's definition of competitive advantage (1985) in terms of value and a company's performance could be considered and conceptualised as equivalent to the particular net benefits of the price paid (Sigalas & Pekka Economou 2013) to suggest that improving sustainable performance are valuable because it can provide a company with a competitive advantage.

Since a competitive advantage stems from superior performance (Delery & Roumpi 2017), improving the measures of performance can make a competitive advantage (Sigalas & Pekka Economou 2013; Sigalas, Pekka Economou & Georgopoulos 2013). Therefore, improving the measures of sustainable performance has the potential to create a competitive advantage in the context of sustainability. Moreover, the RBV argues that a company's capabilities and competencies are sources of competitive advantage. Thus, restructuring and bundling these resources based on customers' requirements and market orientation act as a means of creating a competitive advantage.

Scholars argue that a competitive advantage can stem from a high sustainable performance (Sigalas & Pekka Economou 2013; Sigalas, Pekka Economou & Georgopoulos 2013). In addition, several leading views in business strategy such as a market-led perspective, industrial organisation perspective and an RBV or a dynamic capabilities perspective claim that the concept of competitive advantage seems to always be tied to superior performance (Delery & Roumpi 2017; Sigalas & Pekka Economou 2009). Academics such as Grahovac and Miller (2009) define and measure competitive advantage in terms of company performance because of an inability to operationalise competitive advantage by creating a valid measure (Delery & Roumpi 2017; Sigalas & Pekka Economou 2013). Although acknowledging that these terms are conceptually distinct, they define and operationalise competitive advantage strictly in terms of superior performance and it is quite common in the literature (Delery & Roumpi 2017; Sigalas & Pekka Economou 2013; Arend 2010; Foss and Knudsen 2003; Grant 1998).

Measures of sustainable performance are various, and each business can apply relevant developed measures to its activities. Although the sustainable performance is a common context among several types of business, there are some differences such as activities in manufacturing and service sectors from a strategic perspective. Since this study investigates the sustainable performance in logistics, there is a need to find and choose appropriate measures of sustainable performance in logistics business. Therefore, the next section discusses logistics business, competitiveness and sustainable performance in this business with its measures.

2.7 Logistics

After an evolution in the global market in the latter half of the twentieth century, logistics activities are now found in all types of companies such as governments, service sectors, hospitals and manufacturing. Previously, logistics was defined as an aspect of military science including procurement, maintenance and the transportation of military material, facilities and personnel (Gao 2013). The term logistics is used extensively for describing activities consisting of transportation, storage and the handling of goods, as well as the movement from raw material sources, right through to the process at the point of sales or consumption (Abduaziz et al. 2015). Logistics management concentrates on the whole integration of the required activities for goods movement along the supply chain. Coordination of typical activities including freight forwarding, storage and packaging, managing inventory, and material handling, which are the main targets of logistics to meet customer needs at a minimum cost (Abduaziz et al. 2015).

Logistics affects form, time, place and possession (Coyle et al. 2016). The Council of Supply Chain Management Professionals (CSCMP) defined logistics in 1998 as:

> ‘that part of the supply chain process that plans, implements, and controls the efficient flow and storage of goods, services, and related information from the point of origin to point of consumption in order to meet consumers' requirements’ (Stock & Boyer 2009, p. 693).

This definition considered only the functions or components of logistics at that time in 1998 and so there was no consideration given about how functions should be carried out and what objectives could be achieved. Thus, the definition needed to be improved and was revised again by the same council as:

> ‘that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point-of-origin and the point-of-consumption in order to meet customers' requirements’ (Stock & Boyer 2009, p. 4).

This definition has come now to cover several functions of logistics management from the source of the raw material to the final point of consumption of information and goods flow, with an emphasis on efficiency and effectiveness. In this way, the logistics industry includes several types of logistics service providers offering logistics services.

The significance of logistics is in the way that it smoothe the relationship between supply and demand, and how it manages supply activities scientifically because logistics facilitates movement and coordinates supply and demand (Gao 2013). Hence, logistics is responsible for demand at the right time and the right place. According to Gao (2013, p. 13) logistics is:

> ‘the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organisation and its marketing channels in such a way that current and future profitability are maximised through the cost-effective fulfilment of orders’

Thus, logistics activities comprise of seamless flows of information between a company downstream and upstream while maximising profits. This acts as a driver for higher performance (Gao 2013).

Many issues encourage companies to outsource activities to logistics companies, such as the high costs of transportation, inventory, the need to meet customers' requirements at the right place and the right time, and the high competitiveness of today's market. The most popular areas of outsourcing are therefore relevant to logistics and transportation (Rouquet, Goudarzi & Henriquez 2017; Selviaridis et al. 2008). That is, logistics companies can carry out logistics activities more efficiently and effectively for their service buyers. Outsourcing logistics activities can also benefit manufacturing companies with a substantial decrease in inventory costs and investment. The high significance of logistics is evident in Gligor and Holcomb's (2014) argument based on a resource-based view that companies use logistics as a source of competitive advantage.

Logistics companies benefit businesses by achieving a competitive advantage in cost, differentiation or a combination of both (Gao 2013). Supply chain activities are affected positively by logistics capabilities. Indeed, the unique and critical role of logistics benefits companies in response to the volatility and uncertainty of the market in a timely and effective manner (Gligor & Holcomb 2014).

2.7.1 Logistics actors

Lai (2004) argues that there are four types of logistics service providers. Traditional freight forwarders are the first type, with the lowest capability for carrying out value adding and technology-enabled logistics services. The second type are transformers who are logistics service providers and have a high level of capability in freight forwarding and technology-enabled logistics services. This type of logistics service provider has the capability to perform value-adding logistics services at a medium level. These actors also desire to develop their service offerings comprehensively. Full-service providers are logistics companies providing an extended range of logistics services. Logistics service providers of the last and smallest type have a weak potential for carrying out freight forwarding. In turn, they have the capability to carry out value-adding and technology-enabled logistics services at a much higher level (Lai 2004).

Logistics service providers offer transportation services to a few market leaders (Isaksson 2012). Logistics service providers offer their services in a broad domain and with a wide scope, depending on their type. Logistics service providers can provide value-added services more than traditional logistics functions (transportation and warehousing). As an illustration, they carry out inventory management, logistics coordination, carrier selection and reverse logistics.

Manufacturing companies outsource logistics activities to logistics actors with reduced inventory costs for manufacturing companies. Similarly, warehousing and maintenance costs can be reduced by outsourcing. Freight forwarding, fleet management/operation, product assembly and kitting, spare parts fulfilment and marketing services are other services which are offered by logistics service providers. These types of logistics functions can also benefit manufacturing companies via improvement in on-time delivery and customer relationships, as well as improving profitability for manufacturing companies. Logistics companies also offer security services, project management, logistics information and IT, contract manufacturing and management of call centres (Isaksson 2012) in order for them to manage a supply chain and network efficiently.

> According to Isaksson (2012, p. 8), the CSCMP defines logistics service providers as:
>
> ‘any business which provides logistics services including those businesses typically referred to as 3PL, 4PL, LLP. Services may include provisioning, transport, warehousing, packaging’

According to Isaksson (2012, p. 8):

> ‘Third-party logistics are activities carried out by a logistics service provider on behalf of a shipper and consisting of at least transportation. In addition, other activities can integrate into the service offering, such as warehousing and inventory management; information activities, such as tracking and tracing; and value-added supply chain activities, such as secondary assembly and installation of products’.

Fourth and fifth party logistics providers are non-asset leading companies which provide consultant services to the several companies within the supply chain and supply network respectively. Therefore, third party logistics service providers are a concentrated part of the logistics industry, which carry out several types of logistics activities. Figure 2.1 shows different types of logistics service providers in a pyramid.

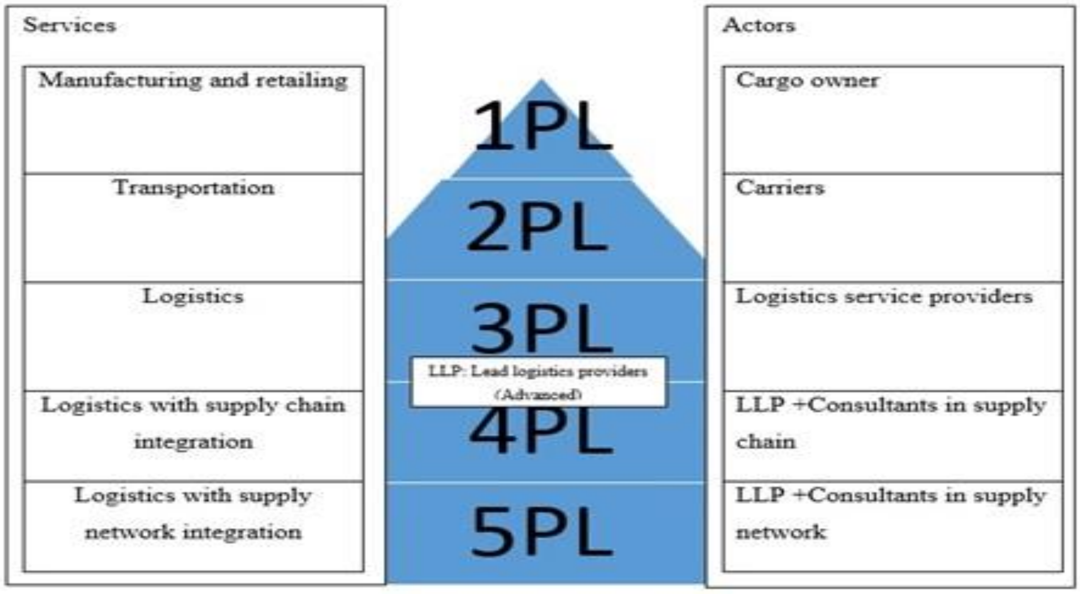

Figure 2.1 Types of logistics service providers
Source: Higgins and Ferguson (2011, p. 14)

Several actors offer different levels of services. First party logistics (1PLs) are cargo owners and their services are manufacturing and retailing. Second party logistics (2PLs) are carriers and they offer transportation services. The types of logistics activities increase from 1PL to 3PL. Third party logistics service providers carry out several logistics functions more than both 1PLs and 2PLs. Lam and Dai (2015) claim that third party logistics is known by its multiple offerings, and bundled services, rather than just for the functions of isolated transport or warehousing. Third party logistics providers within the supply chain support intermediaries between suppliers and buyers (Hertz & Alfredsson 2003). Logistics service providers require a close understanding of the needs of their customers because logistics service providers perform the functions of logistics on behalf of their customers (Lam & Dai 2015). Third party logistics offer a wide variety of services consisting of transportation (air, road truck, sea, rail and pipeline), warehousing, freight forwarding, inventory management, distribution, packaging and labelling as well as cross docking.

Lead logistics providers (LLPs) are parties which carry out services at advanced levels. Fourth party logistics providers (4PLs) perform logistics services with supply chain integration. Indeed, the 4PLs are lead logistics parties who offer consultants in a supply chain. They are non-asset based companies who offer consulting services for logistics. Transportation and supply chain management, outsourcing designing, planning and programming and control are all logistics functions carry out by professional companies. Finally, fifth party logistics are also LLPs who offer consultants in a supply network. 5PLs carry out logistics services and develop business in cyberspace (Lam & Dai 2015). Their activities are procurement, combining the demands of 3PLs, and negotiation with air and shipping lines for high load carrying capacity are their activities such as DHL company in Australia offering commerce logistics consultant and a wide range of solutions that can be tailored to other business' particular needs to optimise and improve their supply chain and help them to achieve a competitive advantage . DHL, for example, designs tailor-made solutions to the complex logistics problems in several industries with its experts. LINFOX company in Australia is another 5PLs logistics companies offering consulting services like supply chain solutions, high security network, industry solution for complex logistics problems, logistics IT, network design as well as other logistics services such as transportation, warehousing and distribution. YOUSEN Australia is another example of 5PLs because this company is a lead logistics service provider that offers and manages solution engineering, logistics technology, reverse logistics, project cargo, temperature-controlled services and information technology within the supply chain as well as other transportation services via air, road and ocean. Thus, 4pls and 5PLs offer non-physical services which have fewer negative impacts on the environment than other logistics services as well. According to Gruchmann, Melkonyan and Krumme (2018), 6PLs are the new generation of logistics companies which play the role of the lead sustainability service providers. Gruchmann, Melkonyan and Krumme (2018) suggest a roadmap for the logistics sector by considering various strategies including growth, replication, mimicry, and mergence to meet future societal and environmental needs and contribute to theory by constructing the Lead Sustainability Service Provider (6PL) business model and its role in societal transitions. Therefore, 6PLs are those logistics service providers integrating sustainablity requirements to their services.

Coyle et al. (2016) compare 3PL and 4PL as spin-off elements of a supply chain and state that 3PLs are single source 3PL contract logistics companies carrying out an individual or multiple logistics activities. They conduct transportation management in domestic versus international spheres. 3PLs carry out value-added warehousing and the distribution management of logistics service software while 4PLs are lead logistics providers that offer advanced services. 4PLs manage multiple 3PLs and take on more risk than 3PLs. They provide advanced information technology (IT) services, strategic consultancy and control tower services. Management of assets thus changes to management of information, knowledge, relationships, innovation and integration through the evaluation of outsourcing (Coyle et al. 2016). Since lead logistics companies including 4PLs and 5PLs are consultants and offer logistics services in cyberspace, they do not offer only physical logistics functions such as transportation, packaging and warehousing. Lead logistics providers take on more risk than other actors because they manage advanced services in supply chains and networks. Offering advanced services in cyberspace has less negative effects on the environment compared with the carrying out of physical services. Thus, 3PLs with a wide range of physical logistics functions affect the environment negatively. Offering a wide variety of physical services create competitiveness between logistics service providers as service actors.

2.7.2 Competitive advantage in logistics as a service actor

Companies can capture a desired market position, increase profitability and build strategic barriers to competition with service offerings (Gebauer 2008; Neely 2008; Vandermerwe & Rada 1988). The identification and development of valuable, rare, inimitable, and organised resources and capabilities are the results of service promotion, which has led to causal ambiguity and social complexity (Eloranta & Turunen 2015). These resources comprise of installed base, service-improved relationships, and rare and complex product-service offerings (Eloranta & Turunen 2015; Gremyr, Löfberg & Witell 2010; Ulaga & Reinartz 2011), which can provide a competitive advantage (Barney 1991). In addition, the dynamic capabilities model states that a sustainable competitive advantage is created by specific service-related capabilities and particular capabilities are required for organising service-related resources to leverage competitive advantage (Gustafsson et al. 2010; Kindström, Kowalkowski & Sandberg 2013).

To build a strong logistics competitive advantage as well as sustain it, logistics resources, either tangible or intangible, should be managed correctly to obtain distinctive logistics capabilities (Alkhatib et al. 2015). Each company tries to manage its resource based on its perception of any source of competitiveness, and the appropriate approach to it. The results of empirical research by Liu et al. (2010) have revealed that a RBV is a more appropriate approach in this context, and capabilities inside companies have significant effects on leading to a logistics service providers' competitiveness. They, therefore, require greater attention than environmental factors. Although service quality capability is the most critical element for a logistics service provider (Liu et al. 2010), there are several specific capabilities to be considered such as operational management, cost management, and customer relationship management (Liu et al. 2010). These capabilities increase customer satisfaction and their loyalty via value-added services. Thus, they have the potential to provide a competitive advantage for a logistics company.

Specific capabilities are required for further development phases of a company. In addition, value-added services, which are among the new trend of logistics, are an opportunity for logistics companies to differentiate their service offerings in relation to their competitors (Isaksson 2012). Thus, logistics service providers, for example, can use environmental initiatives to develop and customise their services based on fully satisfying the customers to cover their growing interests and requirements (Murphy & Daley 2001). Christopher (2005) developed Porter's matrix of competitive strategy for the service sector in Figure 2.2 and argues that the ability of a company to show itself as different from competitors and to operate at a greater profit and lower costs are sources of competitive advantage.

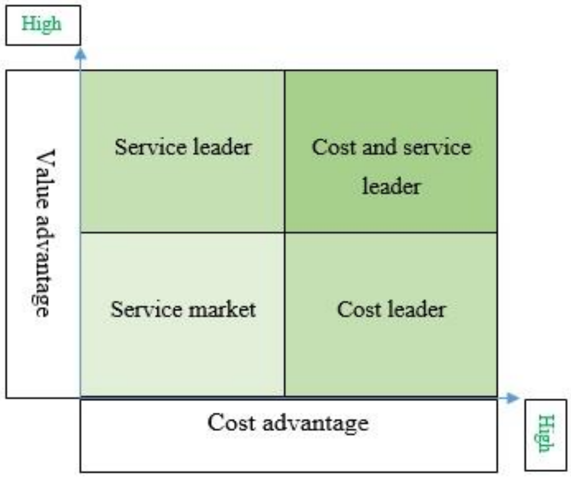

Figure 2. 2 Logistics and competitive advantage

Source: Christopher (2005) cited in (Gao 2013, p. 20)

Although competitive advantage can be achieved by companies through being either a service leader with differentiation or cost leader with lower costs, leading companies in the future market have to reach both peaks (Gao 2013). Hence, different service offerings and lower costs can be sources of competitive advantage for logistics companies in the service sector. Environmental adoption in logistics services seems an opportunity for creating service differentiation and making a logistics company a leading company in the market. Furthermore, cost reduction is a consequence of the implementation of environmental activities and can lead to lower costs. Hence, based on Porter's view (1985), adoption of environmental activities can facilitate the creation of a competitive advantage.

The trend of emerging factors to select and evaluate logistics companies demonstrates that cost and delivery were the basic criteria for evaluating logistics services between 1966 and 1990 and quality was added after 1990 until 2008. After that, cost, quality, the flexibility of service, financial measures, sustainability and delivery were used as evaluation criteria from 2008 to 2015 (Alkhatib, Darlington & Nguyen 2015).

According to Alkhatib, Darlington and Nguyen (2015), previous papers in logistics evaluation and selection showed that there has not been an appropriate comprehensive framework developed with balanced tools because the following have been ignored: logistics sustainability, logistics resources, logistics outsourcing risks, and value-added services factors in logistics. Thus, the level of sustainability performance has become a cutting-edge criterion for evaluating logistics companies in more recent years. The degree of adoption of environmental activity can be a criterion for evaluating logistics companies and in having an appropriate holistic tool for evaluating logistics, which can create a more superior competitive position for companies (Alkhatib, Darlington & Nguyen 2015; Alkhatib et al. 2015).

2.7.3 Sustainable performance in logistics

There are four levels of sustainable performance oriented towards sustainable activities: reactive, defensive, accommodative and proactive (Schrettle et al. 2014). The reactive level is less than required, while the proactive is more than required. The level of sustainability orientation then increases from reactive to proactive. The sustainable performance of a defensive company is the least that is required, and an accommodative company does all that is required. In addition, proactive sustainable performance can lead to competitive market advantage through customer retention and expansion (Schaltegger et al. 2014). It seems that this statement is extendable to proactive environmental performance as a part of sustainable performance aspects. A key dimension for enterprises in implementing environmental activities such as environmental supply chain management is internal awareness. Proactive companies adopt greater activities beyond the requirements of the regulations while reactive companies only adopt compliance with regulatory requirements (Zhu, Sarkis & Lai 2007).

Research by Lorentz et al. (2011) on benchmarking environmental logistics performance in different sized companies in China and Japan has revealed that environmental implementation has basically two reactive and proactive approaches. Smaller companies with limited resources can adopt a reactive approach using environmental activities only to comply with environmental regulations and for a reduction in production costs. However, a proactive approach to environmental activities implemented by large companies may be adopted as a rare capability for adding value to products, plus additionally complying with regulations and incorporating a cost saving approach. Leading companies desire to develop environmental logistics as a rare capability to achieve a long-term competitive advantage over their rivals. Consequently, a RBV can benefit them for environmental logistics incorporated as part of a long-term strategy for their business. (Lorentz et al. 2011).

Karia and Wong (2013) argue that key determinative factors of logistics performance are logistics resources and capabilities based on the RBV to develop resource-based logistics view. The ability of logistics service providers to add value to the bottom line of their clients is a significant factor in competitiveness (Panayides & So 2005b). Moreover, the development of skills, competencies and scale/scope advantages which are superior to competitors are imperative to add customer value. Developing logistics service capabilities not only adds value to customers but also leads to an increase in market share, satisfaction of customers, a differentiation-based competitive advantage and the facilitation of market segmentation (Hertz & Alfredsson 2003). To measure sustainable performance in logistics, it is necessary to identified relevant measures in this business.

2.8 Sustainable performance measurement

To evaluate sustainable performance, the primary step is finding correct measures. Financial indexes such as profit margin, return on investment and sales volume have been used to measure it for years (Kunle, Akanbi & Ismail 2017; Ahi & Searcy 2015; Sigalas & Pekka Economou 2013). Nevertheless, in the emerging sustainability context, economic measures are not sufficient to evaluate performance comprehensively (Raut, Narkhede & Gardas 2017; Schulz et al. 2016). Highly competitive markets will likely require more than economic outcomes to develop a competitive advantage due to influences from external forces and outside stakeholders. According to Lu et al. 2018, further research is required to develop and investigate the social dimension of performance of the circular economy. Thus, advantage needs to extend into the sustainability context, which has three dimensions: economic, environmental and social (Raut, Narkhede & Gardas 2017; Schulz et al. 2016). In addition, strategies with social and environmental dimensions will become increasingly significant in developing a competitive strategy (Schulz et al. 2016). Consequently, evaluation of performance needs a holistic approach and an appropriate tool for considering all dimensions of sustainability.

Sustainable performance has latent measures such as customer satisfaction as well as market share and profitability (Gómez-Bezares, Przychodzen & Przychodzen 2017; Bhat & Darzi 2016), but companies fail to focus carefully on latent measures. The latent measures of competitive advantage are relevant to intangible resources. Since intangible resources can be sources of competitive advantage based on a RBV and four introduced features of a sustainable competitive advantage by Barney (1991) (Hill & Jones 2012), measurement of intangible resources needs a holistic tool with the ability to measure latent indexes (Raut, Narkhede & Gardas 2017).

Identifying measures in each dimension of sustainability and collecting them together is a way for scholars to develop more holistic measurements (Schulz et al. 2016). To measure sustainable performance, it is better to divide it based on a triple bottom line of sustainability, including economic, social and environmental parts and their indexes (Raut, Narkhede & Gardas 2017; Schulz et al. 2016). For example, revenue growth, gross margin growth, earnings before interest, taxes, depreciation, and amortisation (EBITDA), and return on assets are economic aspects (Schaltegger & Wagner 2017; Testa & D'Amato 2017).

Environmental indexes include energy consumption (Song et al. 2018), pollution control and carbon disclosure project score (Hoover & Fafatas 2018; Song et al. 2018), the environmental performance of suppliers (Sinha & Anand 2017) and material usage/waste (Priarone et al. 2017) (Ahmed et al. 2017) to evaluate the level of environmental achievement. Social aspects consist of employee satisfaction (Bernal-Conesa, de Nieves Nieto & Briones-Peñalver 2017; Wisse et al. 2018), community support/ involvement (Wang & Sarkis 2017), charitable contributions (Hategan & Curea-Pitorac 2017) and social performance of suppliers to examine the level of social achievement. (Schulz et al. 2016; Schaltegger & Wagner 2017). Although some measures are relevant to only one dimension of sustainability, there are some measures which belong to more than a sustainability dimension. For instance, environmental costs and the level of process management have dyadic natures including both economic and environmental dimensions (Ahi & Searcy 2015).

Another dyadic measure is to treat hazardous materials safety with social and environmental dimensions together (Sarkis, Helms & Hervani 2010) because it can affect both society and the environment positively. In addition, supporting community projects and customer satisfaction that are suggested by Neely, Ahi and Searcy (2015) are examples of measures including social and economic dimensions. There are also triad nature measures that include three dimensions of sustainability such as green image, quality and product characteristics (Ahi & Searcy 2015). Table 2.1 shows a collection of the measures of sustainable performance for all businesses that can choose based on business activities. These indexes are used for evaluating the performance in the context of sustainability.

Table 2.1 Sustainable performance measures

Type of dimension	Sustainable performance measures	Authors
Economic	Profitability	Ahi & Searcy 2015; Anderson, Fornell & Lehmann 1994
	Gross margin growth	Schulz et al. 2016
	Market share	Mishra, Sinha & Koul 2017; Ahi & Searcy 2015; Anderson, Fornell & Lehmann 1994; Brander & Spencer 1985; Kuzma & Shanklin 1992; Miller, Gartner & Wilson 1989; Sigalas, Pekka Economou & Georgopoulos 2013; Welford 1999
	Sale volume/ sale growth/ sale revenue/ revenue growth	Lee 2013; Schulz et al. 2016; Sigalas, Pekka Economou & Georgopoulos 2013
	Demand rate	Ahi & Searcy 2015
	New market opportunity	Welford 1999
	Return on investment	Ahi & Searcy 2015; Greenyer 2006
	Return on assets	Schulz et al. 2016

	Cost saving	Ahi & Searcy 2015
	EBITDA (earnings before interest, taxes, depreciation, and amortisation)	Schaltegger & Wagner 2017; Testa & D'Amato 2017; Fridson 1998; King 2001; Schulz et al. 2016
	Tax breaks	Ahi & Searcy 2015
	Value added	Schulz et al. 2016
Environmental	Project score of carbon disclosure (CO2 emission)	Hoover & Fafatas 2018; Song et al. 2018; Ahi & Searcy 2015; Lam & Dai 2015; Schulz et al. 2016
	Greenhouse gas emissions	Hoover & Fafatas 2018; Song et al. 2018; Lam & Dai 2015
	Environmental performance of suppliers	Mishra, Sinha & Anand 2017; Schulz et al. 2016
	Energy consumption	Song et al. 2018; Ahi & Searcy 2015
	Recycling	Ahi & Searcy 2015
	Material usage/waste of solid, water	Priarone et al. 2017; Lam & Dai 2015; Schulz et al. 2016
Social	Employee satisfaction	Bernal-Conesa, de Nieves Nieto & Briones-Peñalver 2017; Wisse et al. 2018; Schulz et al. 2016
	Community support/involvement	Wang & Sarkis 2017; Ahi & Searcy 2015; Neely, Ahi & Searcy 2015; Schulz et al. 2016
	Health and safety (work safety and labour health)	Ahi & Searcy 2015; Neely, Ahi & Searcy 2015; Sarkis, Helms & Hervani 2010
	Charitable contributions	Hategan & Curea-Pitorac 2017; Schulz et al. 2016
	Social performance of suppliers	Jabbarzadeh et al. 2018; Zeng et al. 2017; Schulz et al. 2016
Dyadic (economic and environmental)	Environmental costs	Ahi & Searcy 2015
	Level of process management	Ahi & Searcy 2015
Dyadic (social and economic)	Perceived opportunities for advancement	Ahi & Searcy 2015
	Economic welfare and growth	Neely, Ahi & Searcy 2015
	Supporting community projects	Neely, Ahi & Searcy 2015
	Customer satisfaction (loyalty and retention)	Bhat & Darzi 2016; Ahi & Searcy 2015; Anderson, Fornell & Lehmann 1994; Rust & Zahorik 1993
Dyadic (social and environmental)	Treat hazardous materials safely	Sarkis, Helms & Hervani 2010
Triad	Product characteristics	Ahi & Searcy 2015
	Quality	Ahi & Searcy 2015
	Green image	Ahi & Searcy 2015

As can be seen in Table 2.1, some measures have more than one dimension, which can be qualitative, quantitative or relative (Ahi & Searcy 2015). For instance, customer satisfaction has both economic and social dimensions (Ahi & Searcy 2015; Anderson, Fornell & Lehmann 1994). Albeit predicting the impact level of the company on customer satisfaction may be difficult, some programs can affect it positively. Customer satisfaction or customer loyalty is a latent factor but there are some programs such as customer lifetime value, retention rate and visit frequency which are used by companies that make customer loyalty possible and accountable (Bhat & Darzi 2016).

Some social indexes such as health and safety are qualitative but can be quantitative such as the number of health and safety incidents (Neely, Ahi & Searcy 2015). Since work safety and labour health is one of the work conditions and working conditions have significant positive relationship with employee satisfaction (Sengupta, 2011); thus, employee satisfaction is considered as a social measure of sustainable performance. Similarly, some measures in the environmental dimension such as environmental management system and ISO 14000 certification are qualitative (Ahi & Searcy 2015) while a number of environmental indexes can be measured such as reduction of air emissions (Ahi & Searcy 2015). The type of product or material flows can cause safety issues for employees. For instance, functions that cause air emissions or spillage of hazardous chemicals may be more unsafe for workers than sorting processes and disassembly operations (Sarkis, Helms & Hervani 2010). Thus, material usage, energy consumption and air pollution are some indexes which are considered as measures of sustainable performance.

In terms of economic measures, some of them are used in this study. For example, there are several factors, which have influences on output results among ROI. Thus, recognising the ROI of each project needs to isolate the effects of every project and converting data to monetary value through the use of complex techniques especially when the recognition is about effects of training (Philips 2012). Superior customer service leads to improved sales and an increased profit, and subsequently, a higher ROI. Likewise, other areas of organisation can be explored. By measuring ROI and the impact of the logistics policies on it, significant insights can be gained about the financial health of the supply chain. Although when the total cash flow time is determined ROI can readily be combined with profit (Gunasekaran, Patel & Tirtiroglu 2001), it can be vague to recognise the exact amount related to environmental investment. Increasing in revenue and costs savings lead to improve profitability because they are two main factors of profitability (Kaplan 1998; Meier 2010).

Logistics companies can reconfigure their services with the adoption of environmental activities to make differentiation and achieve lower costs as well as use environmental functions as specific capabilities for creating a competitive advantage. Based on the RBV, environmental activities in logistics can be considered as capabilities which have the potential to provide a competitive advantage through improving the measures of sustainable performance. Therefore, next chapter will discuss the literature on environmental adoption, its benefits and the environmental activities in logistics to form the conceptual framework of this study.

2.9 Summary

This chapter introduced the competitive environment of business and the needs of business to seek ways of remaining in uncertain conditions of the global market. Gaining profitability is crucial for companies to maintain business sustainability. Therefore, businesses seek ways to benefit them to reach superior profitability. Companies also need to measure competitive advantage. The emergent sustainability context affects businesses. Thus, it seems that competitive advantage can be measured in the sustainability context in today's business. Since evaluation of achieving competitive advantage includes several measures, it needs a holistic measurement in the triple bottom line - economic, environmental and social dimensions - of sustainability. Moreover, these measures are varies based on the business scope. Although scholars identify comprehensive measures for evaluating competitive advantage in a sustainability context, these studies are in an infancy period. Thus, considering competitive advantage in the sustainability context and identifying relevant measures can be useful to develop these studies. Superior performance is a means of creating competitive advantage (Anwar, Khan & Khan 2018; Delery & Roumpi 2017). Thus, improving measures of sustainable performance may provide a company with a competitive advantage in the sustainability context. Since companies look for a range of means of gaining competitive advantage, environmental adoption seems to act as another means to gain a competitive advantage in the global market. This study focuses on logistics industry and investigates that environmental adoption may improve sustainable performance and improving sustainable performance may act as a means of achieving a competitive advantage in logistics industry. The next chapter explains environmental activities in general and for logistics businesses, several influencing factors that affect environmental adoption and specifically in logistics with the necessities and benefits of environmental adoption.

CHAPTER THREE: ENVIRONMENTAL ADOPTION IN LOGISTICS

3.1 Introduction

Increasing awareness of environmental issues has been affecting the business world (Centobelli, Cerchione & Esposito 2017). At the end of the twentieth century, the notion of environmental focused business emerged and led to growing public concern about sustainable development (Čekanavičius, Bazytė & Dičmonaitė 2014). Environmental adoption as part of sustainable development has several benefits for companies as well as protection of the environment. Environmental management and processes in the supply chain not only pose a threat to the environment, but also benefits companies as a strategic tool for gaining competitive advantage (Kwak, Seo & Mason 2018; Trivedi 2016). Environmental activities benefit companies by bringing a reduction in waste and energy consumption as well as increasing cost savings. Reduction in pollution such as greenhouse gas emissions, noise and solid waste are also some of the positive impacts of adoption of environmental activities. Environmental activities also minimise the negative impacts that companies can have on the environment (Rao & Holt 2005).

Since logistics plays a vital role within the supply chain and contributes significantly to overall greenhouse gas emissions in the world (Centobelli, Cerchione & Esposito 2017; Dubey et al. 2017; Kim & Han 2011), environmental activities for logistics companies have attracted much attention. There are, however, several types of environmental activities which can benefit logistics companies and the environment simultaneously. Economic and environmental advantages are two factors to assess in logistics suggested by several scholars such as Theocharis et al. (2018). Logistics service providers can implement environmental activities based on the domain of service offering because they offer a wide variety of services to their customers. Environmental logistics services can be a source of competitive advantage for logistics companies because developing logistics service capabilities adds value for customers as well as increasing market share, providing satisfaction to customers, enabling a differentiation-based competitive advantage and through facilitating market segmentation (Poulsen, Ponte & Lister 2016; Hertz & Alfredsson 2003).

This chapter reviews environmental activities in the logistics industry including the benefits of environmental adoption, factors influencing environmental adoption and the significance of the role of logistics in environmental adoption. Then, an overview of environmental activities in logistics will also be discussed to provide a context for the conceptual framework of this study.

3.2 Benefits of environmental adoption

The adoption of environmental activity is an important dimension within sustainability. Sustainability was defined by the World Commission on Environment and Development in 1987 as a 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Missimer 2015, p. 1). The concept of a triple bottom line is based on environmental, economic and social aspects to achieve sustainable development (Gómez-Bezares, Przychodzen & Przychodzen 2017; Ahi & Searcy 2015; Elkington 1998).

The interaction between the supply chain and sustainability can keep companies competitive (Evangelista, Colicchia & Creazza 2017; Lee, & Wu 2014; Laari, Töyli & Ojala 2017), if that is, companies attempt to adopt environmental activities more than just the bare minimum. Environmental implementation as an element of sustainability has the same results of adoption. Since one of the significant elements for creating sustainable development is a concern for keeping the environment green, achieving an environmental supply chain seems important (Yadav, Han & Kim 2017; Seroka-Stolka 2014). Corporate environmental strategies for today's businesses and their placing emphasise that environmental implementation can improve competitiveness and commercial attributes in many ways, such as price, quality, features of goods and services, and performance (Seroka-Stolka 2014; Alfalla-Luque, Machuca & Marin-Garcia 2018). Companies can benefit from communication with customers by emphasising on sustainability efforts as a competitive priority (Han & Kim 2017; Lam & Dai 2015).

A supply chain that has an environmental focus, can benefit companies in numerous ways, ranging from reduction in costs to promoting environmental innovations. For example, the adoption of environmental purchasing strategies in response to global concerns about environmental sustainability can act as a solution for waste reduction, a substitution for environmentally-friendly raw materials, as well as a means of minimising hazardous materials (Kwak, Seo & Mason 2018; Rao & Holt 2005). According to Sanchez Rodrigues and Kumar (2019), simultaneous adoption of lean and environmental activities by a wide variety of logistics functions results in several improvements. A decrease in material purchasing costs, energy consumption costs, waste treatment fees, waste discharge and fines for environmental accidents also can assist in gaining benefits for businesses through environmental supply chain management (Tornikoski, Rannikko & Heimonen 2017; Yadav, Han & Kim 2017; Zhu, Sarkis & Lai 2007).

Minimising the negative environmental impacts of products, processes and services, recycling post-consumer waste and the use of environmental management systems can benefit companies by expanding their markets and putting out their competitors that are not capable of promoting strong environmental performance (Mattsson 2016; Klassen & McLaughlin 1996). To conclude, a supply chain with an environmental focus, has the potential to achieve a competitive advantage and economic performance because it can help companies to achieve substantial cost savings, enhance sales, market share and new market opportunities to gain a greater profit margin (Schaltegger & Wagner 2017; Yadav, Han & Kim 2017; Rao & Holt 2005). Finding a significant positive correlation between environmental adoption and economic performance can also encourage companies to implement these activities even more than that in the past (Han & Kim 2017; Rao & Holt 2005; Tan et al., 2015).

3.3 Factors influencing the adoption of environmental activity

There are several internal and external factors which influence companies to implement environmental activities. Some influencing factors are common amongst several types of companies such as legislations and government regulations (Ahani, Rahim & Nilashi 2017; Tacken, Sanchez-Rodrigues & Mason 2014) whilst others differ from one business to another. One of the most effective external factors is government (Ahani, Rahim & Nilashi 2017; Lorentz et al. 2011) which provides both pressures (Isaksson 2012; Walker, Di Sisto & McBain 2008; Wong, Turner & Stoneman 1996) and support (Lin & Ho 2011). For example, regulatory pressure, quality of human resources, relative advantage, and compatibility of environmental activities have had significant positive effects on Chinese logistics companies to adopt environmental activities (Lin & Ho 2011). In this situation, regulatory pressure is an external driver while the other three drivers stem from within the company.

Influencing factors can be divided into three groups including technological, organisational, and factors related to business environment which influence the willingness of adoption of environmental activities positively (Lee et al. 2018, Saberi, Kouhizadeh et al. 2019; Chien & Shih 2007). The explicitness of technology, accumulation of technology and organisational encouragement for acquiring new technologies are technological factors influencing from the internal of an organisation (Ramdhani, Aulawi et al. 2017, Zientara and Zamojska 2018).

Organisational factors include stakeholder pressure, the size of company, industry sector and geographic location, strategic and managerial attitudes, position in the supply chain and characteristics of human resources (Evangelista, Colicchia et al. 2017, Lee et al. 2018; Seroka-Stolka 2014). The size of the company is another internal influencing factor which affects environmental implementation (Evangelista, Colicchia et al. 2017). For example, Hung Lau and Wang (2009) and Walker, Di Sisto and McBain (2008) claim smaller manufacturers are under pressure from business partners within the supply chain due to having strong collaboration among them. Employees' interests can be considered as an internal driving factor in the context of environmental adoption (Zientara and Zamojska 2018; Isaksson 2012). Internal company pressure includes managerial attitude, characteristics of human resource, stakeholder pressure that can grouped as the interest of employee satisfaction in environmental adoption, as well as the company size. All these organisational drivers are internalThus, the size of company and the interest of employees in environmental adoption are considered from this group to investigate in this research study.

There are some factors from the external environment influencing a company's environmental adoption. Environmental certainty, governmental support and environmental innovation are examples of external drivers affecting environmental adoption of a company from the business environment (Ahani, Rahim & Nilashi 2017; Chien & Shih 2007). The pressure of negative media attention and of public authorities, society's perception of the company as external factors and the company's brand as an internal factor can affect the implementation of environmental activities as drivers (Lee et al. 2018; Salomone 2008) because those factors can show a good image of a company to society. For example, a company's attempts to have environmental responsibility can satisfy aware customers and media can play an important role to introduce responsible or irresponsible companies to society. Consequently, a good image for a company affects brand popularity and provides new market opportunities. Increased pressure from investors is a strong internal driver (Walker, Di Sisto & McBain 2008; Lee et al. 2018). Increased competitiveness or economic means of control, the pressure of stakeholders such as top management, employees and customers are also indicated as prominent drivers by Isaksson (2012) and Lee et al. (2018). These drivers are internal except customer pressure.

Customer pressure as an external driver motivates companies to increase investment for greater environmental accomplishment objectives (Testa, Boiral et al. 2018; Tacken, Sanchez-Rodrigues & Mason 2014; Foster, Sampson & Dunn 2000) because aware customers expect to see environmental responsibility from a company. Thus, higher environmental awareness of customers can affect environmental adoption positively (Isaksson 2012; Seroka-Stolka 2014). In terms of supplier pressure, there are opposite ideas. Although Isaksson (2012), Tacken, Sanchez-Rodrigues and Mason (2014) and Hyatt and Berente (2017) claim that pressure from suppliers can be an external key driver to adopt environmental activities, Walker, Di Sisto and McBain (2008) and Salomone (2008) believe that supplier pressure cannot be a driving factor. The company, customer, politics and society also have their effects on the implementation of environmental activities (Lee et al. 2018; Seroka-Stolka 2014).

From a market point of view, existing rivals' adoption of environmental policies and having the aim of being an environmental leader in the market, drive logistics service providers to integrate environmental aspects into their activities to increase market share (Abdala, de Oliveira & Cezarino 2018; Isaksson 2012). Competitor pressure, market competitiveness, the environmental policies of competitors and new market opportunities are significant motivations for companies to implement environmental activities (Tacken, Sanchez-Rodrigues & Mason 2014; Salomone 2008; Dubey, Gunasekaran & Ali 2015). Being capable of setting industry norms and/or legal mandates are the same as having the ability to drive environmental innovation (Henriques & Sadorsky 1999). Some scholars such as Luthra, Garg and Haleem (2015), De Medeiros, Ribeiro and Cortimiglia (2014) and Rezvani, Jansson and Bodin (2015) believe that the price of energy is an influential factor towards environmental adoption.

Although there are several driving factors, the level of these effects on environmental adoption is not equal. As an example, Isaksson (2012) and Lin et al. (2014) state that the pressure of future expectations and their consequences, environmental demand, interest from customers, and a decision from top managers are strong factors in adopting environmental activities. The decision of a top manager is a strong internal driver (Zientara and Zamojska 2018) while the pressure of future expectations, environmental demands and customers' interests are strong external drivers (Isaksson 2012; Lin et al. 2014). However, there are several barriers that affect environmental activity adoption negatively which are not relevant to this thesis due to their negative impacts on adoption of environmental activities.

Overall, influencing factors have their weak or strong impact on a company's environmental adoption. In addition, companies need to adapt to changes to remain in a more competitive global market. Based on the above discussion, several external and internal drivers affect environmental implementation. To cope with the pressures of customers, buyers, communities, government regulators, non-governmental organisations and media who have increasing concern for the environment, an important way forward for companies is implementing environmental activities in their business operations (Ahani, Rahim & Nilashi 2017; Seman et al. 2012; Trivedi 2016). In other words, there is a need for an increasing orientation to an environmental integration with business.

Although some influencing factors such as government regulations push companies to adopt environmental initiatives (Ahani, Rahim & Nilashi 2017), these factors provide a minimum level of environmental adoption which is not sufficient for companies who attempt to create competitive advantage through environmental management and improving sustainable performance in the global market. Thus, some factors such as the potential for achieving competitive advantage can be stronger to influence leading companies who intend to create a competitive advantage through improving sustainable performance and being a market leader. Comparing and evaluating these factors based on their degree of effect on environmental adoption can clarify which influencing factors are more motivating for leading companies to adopt additional environmental activities rather than minimums. Leading companies could be recognised by indicating their level of performance or for example, the type of services offered by them in the logistics industry. Also, their viewpoints about the rank of the influencing factors can show the most and the least influential factors towards environmental adoption.

3.4 Environmentally-friendly supply chains

An environmental business undertakes activities devoid of negative impacts on the environment (Čekanavičius, Bazytė & Dičmonaitė 2014; Green et al. 2012). Thus, an environmental business is committed to environmental sustainability principles in its operations, it strives to use renewable resources, and it minimises the negative environmental impact of its activities. Changing the business to become environmentally focused is a long-term strategy in order for it to become sustainable (Čekanavičius, Bazytė & Dičmonaitė 2014).

Green, Morton and New (1996, p. 188) state that ‘environmentally-friendly supply chain refers to the way in which innovations in supply chain management and industrial purchasing may be considered in the context of the environment’. Dynamic and innovative features are highlighted in the definition of the environmental supply chain. According to Hall (2000, p. 456):

> 'environmental supply chain dynamics (ESCD) are a phenomenon where environmental innovations diffuse from a customer company to a supplier company, with environmental innovation defined as being either a product, process, technology or technique developed to reduce environmental impacts'.

According to Srivastava (2007, p. 54):

> 'integrating environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life'

Although Hall (2000) points out some innovative and dynamic features of a supply chain, he argues that environmental-focused innovations are sent from the downstream to the upstream of a supply chain. Thus, he does not consider all aspects of the supply chain. A definition by Srivastava (2007) covers this gap and presents a more comprehensive understanding of environmental supply chain management. Srivastava (2007) considers the end-of-life management of products and defines it. Hence, environmental thinking has the potential to influence all aspects of the supply chain which includes from upstream to downstream as well as in the converse direction.

Reduction in greenhouse gas emissions is one of the main objectives related to the United Nations' (UN) Conventions on Climate Change and the associated Kyoto Protocol. The levels of reaction have been different in several nations because that depends on the level of a nation's development, the structure of its industry, natural resource availability, its economic activities as well as public perceptions in that nation

(Isaksson 2012). Despite these factors, many governments support an environmental orientation and have been forcing businesses to implement environmental initiatives by using some regulations and policies. For example, in Australia, different maximum penalties are considered for environmental protection offenders depending upon whether as a corporation or an individual and the maximum penalty is generally considered higher for corporations to compare with individuals (Cain & Donnelly 2017).

Rao and Holt (2005) have categorised environmental activities within the supply chain into three clusters. Firstly, inbound activities include holding conferences to give information to suppliers about ways of establishing environmental programs and the benefits of clear technologies and production. These conferences can encourage them to adopt environmental actions. From the inbound perspective of the supply chain, environmental purchasing is a way to reduce any produced hazardous and non-hazardous wastes and substitute that material through environmental sourcing of raw materials. (Hänninen & Karjaluoto 2017; Rao & Holt 2005).

Secondly, there are environmental activities in the production phase including the substitution and use of environment-friendly raw materials, the inclusion of environmental criteria into decision making processes, optimisation as a means for reducing solid waste, air emissions and noise, the recycling of materials internal to the company, and the use of cleaner technology (Rao & Holt 2005). The third cluster involves outbound environmental activities, including environmental labelling, environmental packaging and recycling packaging, an increase in customers' awareness about environment-friendly products and production methods, and an improvement in environmental-friendly transportation. Thus, the scope of environmental supply chain management ranges from environmental purchasing to the integration of environmental supply chains which flows from suppliers to end customers, and even closing the supply chain by incorporating reverse logistics (Hänninen & Karjaluoto 2017; Zhu & Sarkis 2004). The following paragraphs explain several environmental activities along with their advantages.

Environmental enhancement in research and development has several subsets such as respect for environmental issues and engaging in scientific research. Other subsets cover issues like coordinating activities with other retailers to mitigate negative impacts on the environment, putting pressure on suppliers to change packaging, and the use of environment-friendly manufacturing processes (Welford 1999). Environmental management refers to a collection of activities with environmental integration such as environmental manufacturing, reduction in the use of chlorofluorocarbon and a reduction in energy consumption (Sundarakani et al. 2010). It aims to improve recycling and reduce waste by using recycled paper, reduce the amount of product packaging and initiate the adoption of corporate environmental policy (Zhu, Sarkis & Lai 2008). Thus, environmental management includes knowledge and skills which benefit businesses in effectively overcoming issues of resource use, and it shows how companies can protect the environment and improve environmental values.

The four Rs of environmental activity comprise of reduction, reuse, recycling and recovery, which are environmental activities through the supply chain, clustered under the title of reverse logistics (Čekanavičius, Bazytė & Dičmonaitė 2014). According to

Idemudia and Kwakyewah (2018), the Canadian government has interpreted the waste management hierarchy as follows. Firstly, if possible, waste reduction is the preferable option. Secondly, every effort should be made to reuse it if practicable if waste is produced. The third option of the waste management hierarchy is recycling. It is important to remember that there are economic and environmental costs associated with waste collection and recycling, though recycling does help to conserve resources and reduce wastes. For this reason, recycling should only be considered for waste which cannot be reduced or reused. Finally, the materials or energy from waste which cannot be reduced, reused or recycled, could be possible for recovery (Idemudia & Kwakyewah 2018). Converting waste into resources such as electricity, heat, compost and fuel) through the thermal and biological process is what is meant by recovery (Munir et al. 2019). Reduction means reducing resource consumption such as energy consumption and waste reduction including minimising packaging in volume and weight. Companies can use degradable, natural or organic materials in production and/or apply product stewardship policies in regard to the responsibility for waste reduction and recycling. They can also use renewable materials (Čekanavičius, Bazytė & Dičmonaitė 2014). For example, those logistics companies offering packaging and labelling services, can use environmentally-friendly material. Both manufacturing and service factors can benefit from waste management and reduction in resource consumption. These types of activities have the potential to decrease costs because reuse and recycling lead to a reduction in material purchasing. Thus, companies can implement these activities to improve their financial performance and increase their profitability.

Seroka-Stolka (2014) claims that because environmental responsibility and commitment have become a vital concern all over the world, companies are now under pressure to develop their level of environmental orientation. The Economic Co-operation and Development (OECD) states that one of the most significant sectors that are contributing to overall greenhouse gas emissions in the world is actually logistics (Kim & Han 2011). Thus, logistics has a potential set of opportunities now to begin to mitigate the negative impacts on the environment.

3.4.1 The significance of logistics in environmental adoption

Environmental logistics integrates environmental thinking into traditional logistics as part of the supply chain (Centobelli, Cerchione & Esposito 2017; Lorentz et al. 2011). Inbound transportation, packaging of products, delivery and distribution to customers are logistics activities which can be improved by the use of environmentally-friendly raw materials and infrastructure, renewable energy and clean technologies. Environmental activities related to logistics, as defined by Chien and Shih (2007), include the use of recycling material, reduction in water pollution, reduction in air pollution, an increase in energy conservation and a reduction in fuel consumption.

Rapidly emerging environmental initiatives within the supply chain in procurement, manufacturing, distribution and recycling can lead to redesigning the activities of a company's logistics to make activities more environment-friendly and energy efficient (Lorentz et al. 2011). Environmentally-friendly logistics business is an important part of supply chain management with protecting impacts on the environment (Rao & Holt 2005). Figure 3.1 shows the role of logistics in the supply chain.

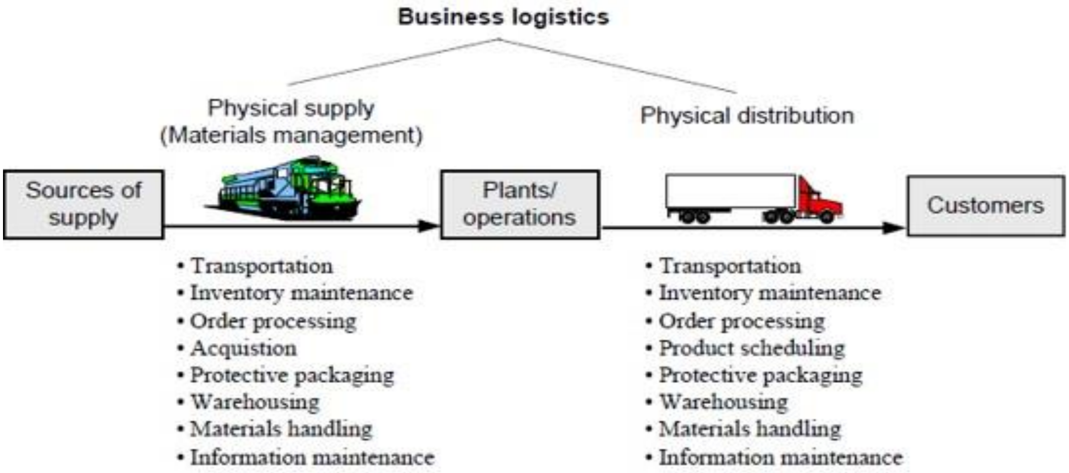

Figure 3. 1. Logistics diagram within the supply chain

Source: Adapted from Ballou (1997)

As can be seen in Figure 3.1, business logistics includes the physical supply and distribution within a supply chain. Logistics companies carry out transportation, inventory management, packaging and warehousing with other activities between the source of supply and customers within a supply chain. The scope of environmental supply chain management ranges from environmental purchasing to the integration of environmental supply chains flowing from the supplier to end customer, and even closing the supply chain by incorporating reverse logistics (Zhu and Sarkis, 2004). Thus, environmental logistics includes all activities with an environmental orientation, both forward and backward, through eco-efficient management flows of products and information between origin points and consumption points to meet or exceed customer demand (Seroka-Stolka 2014). In other words, environmental logistics is an organisational activity integrated into supply chain management (Lee & Klassen 2008) for improving the environmental performance of suppliers and customers. Thus, logistics activities that are environmentally integrated decrease negative impacts on the environment and play a significant role in protecting the environment.

The OECD has suggested that transport is the most significant sector which has contributed to overall greenhouse gas emissions in 2005, reaching a percentage of around 23.3 of carbon dioxide (CO_2) worldwide (Kim & Lee 2012). Freight forwarders are companies organising shipments for individuals or corporations to transfer goods from the manufacturer or producer to a market, customer or final point of distribution and there are several types of freight forwarding (Gusah, Cameron-Rogers & Thompson 2019). Freight forwarding emits roughly eight percent of all $CO_{2,}$ and warehousing and goods handling activities generate an additional two to three percent (McKinnon 2010). According to Piecyk et al. (2015), since transportation use approximately 12% of global energy consumption, this corresponds to a share of around 10%of energy-related CO2 emissions worldwide. Warehousing and material handling are likely to add approximately 2-3 percent to this total. The World Economic Forum and Accenture (2009) have estimated that roughly 5.5 per cent of total global greenhouse gas emissions are emitted by logistics activities. Moreover, they suggest that logistics buildings' emit 9-10% of the total, with the rest coming from freight forwarding (Piecyk et al. 2015).

Moreover, freight transport as an activity of logistics also can have other negative environmental impacts such as through accidents, noise and air pollution (Sanchez Rodrigues et al. 2015; Lin & Ho 2011). Different freight forwarders in Australia are specialised in different modes of transport depends on the type of freight transportation. Freight transportation in Australia includes both local and international air freight, rail freight, shipping and sea freight as well as road transportation (Gusah, Cameron-Rogers & Thompson 2019).

Increasing attention on the logistics industry has come about because of the concept of a carbon footprint and the necessity for the world to manage levels of greenhouse gases (Cullinane & Edwards 2010). This kind of decarbonisation within a logistics operation and carbon auditing in the road freight sector have both provided a rapid and more cost-effective means of seeking opportunities for reduction in pollution (Piecyk 2010).

The effects of different kinds of freight transport modes, the impacts of advances in vehicle technology and stricter regulations on emissions levels are other aspects of environmental logistics which can reduce negative environmental impacts of transport (Isaksson & Huge-Brodin 2013). Minimising costs and maximising profits have been emphasised in traditional logistics. Modern logistics has added environmental responsibility as another core objective to the previous objectives (Kim & Han 2011) because sustainability debates emphasise meeting present needs without compromising the ability of future generations to meet their own needs.

The objectives of traditional logistics, therefore, cannot be sufficient for the global market. New activities in environmentally-friendly modern logistics across the supply chain mainly concentrate on decreasing negative impacts on the environment and improving the efficiency of the supply chain (Abduaziz et al. 2015). Modern logistics thus seeks for achieving three main objectives simultaneously, including gaining minimum costs, with maximum benefits and protecting the environment, although in some cases these objectives are not very well aligned. Replacing cost-effectiveness means that there is a need first for more investment, which will decrease fuel costs as well as minimising negative effects such as emissions in the long term.

Since logistics has such a significant role in the supply chain and can be one of the main sources of pollution, an increase in attention to environmental solutions cannot be ignored (Seroka-Stolka 2014). Consequently, logistics companies are in the position to adopt environmental activities in both transport and non-transport activities (Isaksson 2012). Awasthi, Chauhan and Goyal (2010) argue that when a logistics service is performed, clean technologies can involve efforts towards recycling, and using environment-friendly materials, infrastructure and tools. Logistics companies can opt for renewable energy with lower sulphur fuels and less pollution as an alternative and as a means to protect the environment (Lieb & Lieb 2010). Moreover, logistics plays not only a key role in decreasing greenhouse gas emissions and in the dependency of the economy on non-renewable energy, but also a sector that can make a potential contribution to sustainability. In turn, a sustainability orientation also focuses on measures that reduce logistics costs (Smokers et al. 2014).

The enhancing of human and ecosystem, health and economic progress as well as social justice should be considered along with the need to achieve sustainability in transportation (Lam & Dai 2015), since greenhouse gases and other hazardous emissions and noises affect the ecosystem negatively. Consequently, human health is threatened by these negative effects. Fuel-efficient and carbon neutral transportation, enhancement of inventory and warehouse systems, and correct terminal and warehouse locations should, therefore, be targeted as goals by logistics companies (Büyüközkan & Berkol 2011). Environmental design in warehouses and proper storage of hazardous materials and their disposal are other targets for logistics companies for achieving environmental efficiency (Carter & Jennings 2002; Darnall, Jolley & Handfield 2008; Büyüközkan & Berkol 2011). In this regard, there are several environmental activities which logistics companies can adopt to improve their environmental performance as well as to protect the environment. These types of environmental activities in logistics are important because they have the potential to reduce threat to human life as well as benefitting businesses.

3.5 Environmental activities in logistics

The literature on environmental activities in logistics has developed in the last few decades. Environmental logistics has been defined by the Reverse Logistics Executive Council (2010) as 'attempts to measure and minimise the ecological impact of logistics activities' (Lin & Ho 2011, p.69). According to Lin and Ho (2011), environmental logistics include environmental integration in all aspects of logistics activities such as purchasing, material management and manufacturing, distribution and marketing as well as in reverse logistics. Companies need to implement environmental activities in logistics to have standard, efficient and effective logistics with a fast handling and movement of goods (Lin & Ho 2011).

Since logistics activities increase pollution and have negative effects on the environment, environmental activities are undertaken by retailers, wholesalers and logistics service providers to mitigate negative impacts as well as to maximise logistics efficiency (Kim and Lee 2012; Rogers & Tibben-Lembke 2001). The designing of environmental logistics is a response to customer expectations about environmental requirements on logistics such as energy efficiency, control of greenhouse gas emissions and waste control and treatment (Lam & Dai 2015). For instance, some environmental activities in logistics are issued such as an optimisation of networks, improvement in inventory management, reductions in fuel consumption for vehicles, and improvement in warehouse energy consumption and packaging (Lorentz et al. 2011). Several environmental activities are suggested by scholars, and can be grouped together based on relevant activities. For example, environmental purchasing can be undertaken by logistics companies for packaging and labelling to provide an environmental design. In this way, these activities can be clustered under the title of environmental sourcing and design. To summarise, there are six types of environmental activity: environmental sourcing and design, environmental transportation and fleet management, environmental management systems, environmental warehousing and storage, the use of clean energy with environmental infrastructure, and recycling and reverse logistics. These types of environmental activities are explained in the following pages.

3.5.1 Environmental sourcing and design

Some environmental activities suggested by several scholars can be grouped under environmental sourcing and design. Firstly, environmental purchasing that focuses on purchasing environmental raw materials (Pullman & Wikoff 2017; Hervani, Helms & Sarkis 2005; Karpak, Kumcu & Kasuganti 2001; Rao & Holt 2005). This activity suggests the substitution of environmentally harmful raw materials with environmentally-friendly ones, the buying of recycled raw materials, the use of suppliers who meet environmental criteria and purchasing based on international environmental regulation (Lorentz et al. 2011). In this way, environmental purchasing is a means of reducing manufacturing waste, and it can minimise the waste of hazardous materials from the inbound perspective of the supply chain (Hänninen & Karjaluoto 2017; Bing et al. 2016; Rao & Holt 2005) and it can increase environmental efficiency (González-Benito & González-Benito 2006; Pullman & Wikoff 2017).

Secondly, environmental packaging is relevant to logistics companies as an activity of environmental sourcing and design (Prakash & Pathak 2017; Wu & Dunn 1995). In addition, there is a positive relationship between packaging and value creation (Rundh 2016). Thus, environmental packaging in the global market, which is affected by environmental debates, can improve market share. Recycled packaging materials and environment-friendly designs for packaging can also decrease waste (Lorentz et al. 2011). Thirdly, the use of environmental labels can positively influence public perceptions and thereby benefit the company through its demonstration of high corporate social responsibility to all stakeholders (Čekanavičius, Bazytė & Dičmonaitė 2014). Providing information to customers and cooperation with them can increase consumer attraction, the company's public standing, brand awareness, and opportunities for improvement (Zhu et al. 2008). The object of environmental packaging and labelling is therefore to take advantage of market forces by providing consumers with information about the environmental profile of their products (Prakash & Pathak 2017; Lavallée & Plouffe 2004; Rundh 2016). Businesses can motivate consumers' interest in issues of the environment and develop a purposive demand for particular types of products.

There are suggested activities under environmental sourcing and design by scholars which can reduce waste and any negative impacts on the environment with a reduction in the use of sources. For instance, the use of environmental-friendly materials, tools and design (Awasthi, Chauhan & Goyal 2010), as well as the use of cleaner technology and recycled packaging materials (Crumrine et al. 2004; Pullman & Wikoff 2017) are activities in the environmental purchasing subset. In addition, there are other environmental activities which can improve environmental purchasing such as taking back waste packaging materials from customers for recycling (Lorentz et al. 2011), and recycling packaging material and design (Crumrine et al. 2004; Kim & Han 2011). However, these activities belong to recycling and reverse logistics and are considered in the recycling group in this study. Reducing the use of transport packaging and using recyclable logistics containers (González-Benito & González-Benito 2006; Zhang et al. 2014) are also an integral part of environmental sourcing and design cluster. Environmental packaging and labelling as a subset of environmental design and sourcing contains the activities like labelling with environmental enhancement and a reduction in the amount of product packaging (Prakash & Pathak 2017; Kim & Han 2011).

Clean energy with environmental infrastructure suggests the use of alternative energy with lower sulphur fuel for the control of greenhouse gas emissions and a reduction in pollution. Some scholars such as Lam and Dai (2015) and Awasthi, Chauhan and Goyal (2010) propose the use of clean technology, electronic communication and information as environmental activities that belong to this activity. Electronic communication decreases the use of waste such as paper and can prove useful in improving recycling as well as facilitating communication. Faster communications have the potential to improve relationships with customers and so raise customer satisfaction levels. Thus, electronic communication can increase cost savings and profitability both directly as well as indirectly. Energy consumption improvement is an important outcome which can motivate the undertaking of these activities (Lin & Ho 2011). Overall, each actor in logistics can carry out one or all of these activities because of the scope of logistics service providers, extending their scope from the simple offering of a single activity towards a wider range (Isaksson 2012). The use of environmentally-friendly energy sources is opted as the main activity of this group because logistics companies as a service sector do not use materials as in the case of manufacturing companies.

3.5.2 Environmental transportation and fleet management

Recently, several scholars such as Sanchez Rodrigues et al. (2014) highlight the significance of internal freight transport chains and supply chain in terms of investigating the options for the use of alternative ports and carbon mitigation strategies. For instance, port expansion, container handling and freight transport are three main elements of the model adopted by Sanchez Rodrigues et al. (2015) to develop a model for assessing possible carbon mitigation strategies for United Kingdom supply chains. Environmental transportation as a basic function of logistics has activities that decrease negative impacts on the environment (Ellram & Murfield 2017; Lorentz et al. 2011). In this regard, there are several environmental activities, which are proposed by scholars. For example, optimising logistics performance, optimising transport load distribution, and choosing the right mode of transport are suggested by Zhang et al. (2014). Other activities suggested by Zhang et al. (2014) for decreasing energy and fuel consumption are the use of intensive modes of transport (containers, or transportation with dumping trailers), as well as the employment of improved or innovative handling systems. A reduction in fuel and energy consumption directly mitigates pollution through emissions.

These can improve logistics efficiency as well as protect the environment by reducing mileages and fuel consumption. Undertaking these activities is therefore important as they have the potential to reduce negative emissions such as carbon dioxide and noise. They also serve to improve the health of society. According to Harris et al. (2018), the distance and method of carriage as well as cargo mass are some elements of the amounth of CO2 emissions. Schedule optimisation and the use of order consolidation can also reduce distribution frequency and fuel consumption (El-Berishy & Pannek 2017; Lorentz et al. 2011) with the same benefits. Environmental transportation can also include other suggested activities such as the use of energy efficient vehicles to optimise efficiency, better routeing and scheduling for optimisation of the distribution process (El-Berishy & Pannek 2017; Lorentz et al. 2011).

Environmental efficiency of transportation and fleet management can also improve through other activities such as the use of fuel-efficient and carbon neutral transportation, energy efficient movement (Ellram & Murfield 2017; Büyüközkan & Berkol 2011; Lam & Dai 2015), optimisation of networks (El-Berishy & Pannek 2017; Lorentz et al. 2011), and use of order consolidation (Centobelli, Cerchione & Esposito 2017; Wu & Dunn 1995). Optimising transport routes and load distribution, choosing the right mode of transport and monitoring vehicle driving mileage are other activities in this group that are proposed by Zhang et al. (2014) for protecting the environment and enhancing the environmental performance of logistics companies. Optimisation transport routes is an important factor in decision making for logistics service providers which may affect their competitiveness. Theocharis et al. (2018) conduct a systematic literature review to evaluate the competitiveness of Arctic routes from both economic and environmental perspectives and suggest an initial understanding on route choice decision making factors. Since reduced delivery time is an important factor for satisfying customers, optimisation of transportation can lead to improved customer satisfaction. Since Sanchez-Rodrigues, Potter and Naim (2010) claim that transport uncertainties can increase risk and vulnerability in the supply chain, better scheduling and optimisation of the distribution process can decrease transport uncertainties in the supply chains because these activities reduce risk and vulnerability. In addition, undertaking the above-mentioned activities also can often benefit logistics companies by cost savings, because of the reduction in fuel and energy consumption and in delivery improvements. These benefits can provide opportunities for logistics companies to create a competitive advantage. 'Replacing old vehicles with energy efficient types' and 'optimisation of the distribution process' are the most cited environmental activities to have an environmental transportation (Ellram & Murfield 2017; El-Berishy & Pannek 2017; Zhang et al. 2014; Büyüközkan & Berkol 2011; Lam & Dai 2015). These environmental activities benefit logistics companies by reducing fuel consumption which result in increasing cost savings (Papadas, Avlonitis & Carrigan 2017; Zainuddin et al. 2017; Čekanavičius, Bazytė & Dičmonaitė 2014). Moreover, energy efficient vehicles has innovative design to decrease the pollution and increase the efficiency (Minak, Fragassa et al. 2017). Therefore, these environmental activities are opted to investigate in this study.

3.5.3 Environmental management systems

Environmental management systems manage activities with minimum negative effects on the environment (Giacomo, Guthrie & Farneti 2017; Zhu & Sarkis 2004) by establishing an overall quality environmental management system and picking strategies for minimising negative effects (Evangelista, Colicchia & Creazza 2017;

Suryanto, Haseeb & Hartani 2018; Zhang et al. 2014). In addition, environmental audit programs are other internal management efforts which lead to a higher reduction in pollution emissions (Suryanto, Haseeb & Hartani 2018; Murphy & Poist 2000). Receiving an environmental management certification such as the ISO 14000 series and cooperation with partners or customers in environmental management are defined as activities in this cluster (Zhang et al. 2014). Since the ISO series provide the same and minimum levels of adoption of environmental activities for logistics companies, a company which attempts to be ahead of its rivals through environmental management needs to adopt more than just the minimum. Thus, picking the appropriate strategies can play an important role in providing a competitive position for a company through environmental investment.

The environmental management system also includes the establishment of related corporate environmental management, the selection of partners, and the assessing of their environmental performance, information systems, as well as an audit of environmental performance activities (Evangelista, Colicchia & Creazza 2017; Zhang et al. 2014) which enhance environmental performance. Increasing compliance and reducing waste are the goals of environmental management system through the act of reaching and maintaining minimal legal standards (Evangelista, Colicchia & Creazza 2017). Carrying out knowledge training for employees about environmental management, energy saving and assessments, as suggested by Zhang et al. (2014), can establish employee incentives for developing environmental performance. Environmental innovation and research development activities can be grouped in this type of environmental activity, because engaging in scientific research with respect to ecological issues and coordinating activities, are ways to reduce impact on the environment (Lam and Dai 2015). These can also be part of employees' environmental management knowledge training to improve environmental performance. Although some scholars indicate different activities such as scientific research and training (Lam and Dai 2015), partner selection and environmental performance auditing (Evangelista, Colicchia & Creazza 2017; Zhang et al. 2014), the use of environmental management systems is the most cited activity which include other mentioned activities as its subsets. Therefore, the use of environmental management systems is determined to be the most important indicated activity in this group and used in this research study.

3.5.4 Environmental warehousing and storage

Environmental storage and warehousing focus on reasonably chosen product warehousing, the optimising of storage space, the creating of reasonable layout arrangements and the monitoring of recycling and waste transportation (Zhang et al. 2014). The main objective of this activity is to minimise in-house time which can reduce energy consumption and warehousing costs as well as improve flexible delivery (Liu et al., 2017). According to Apte and Viswanathan (2000), cross-docking as a warehousing strategy includes material movement directly between the receiving dock and the shipping dock so as to minimise in-house time. Cross-docking often leads to substantial reductions in the cost of transportation without increased inventories, while simultaneously maintaining a high level of customer service (Liu et al., 2017). Cross-docking can also reduce the order cycle time, thereby enhancing the distribution network's responsiveness and flexibility. All these benefits can improve company responsibility to customers and increase customer satisfaction and profitability.

Many activities pointed out by scholars under environmental warehousing can decrease some types of costs for companies, and help them to achieve more profitability. Inventory management improvement (Lorentz et al. 2011; Büyüközkan & Berkol 2011; Darnall, Jolley & Handfield 2008), as well as reasonable arrangements for the layout of warehouse space (Zhang et al. 2014) are two examples of these activities. Optimising warehouse order picking strategies, the choice of the correct location for terminal and warehouse, full use of a multi-modal transport hub and logistics centre, proposed by Zhang et al. (2014), can mitigate delivery delay and improve service agility by decreasing mileage. Proper storing and efficient storage activities, suggested by some authors (Büyüközkan & Berkol 2011; Carter & Jennings 2002; Darnall, Jolley & Handfield 2008), can also improve environmental efficiency. Introducing environmental product line landscaping and store design, replacing refrigerants when retired with lower chlorofluorocarbons (CFCs) are also suggested by Lorentz et al. (2011) and Welford (1999), and have the potential to reduce the costs of energy consumption, repairing and maintenance. Thus, these activities can improve financial performance for a company through cost savings. Based on the literature, the most common environmental activities of this group are efficient storage of goods and the use of energy efficient refrigerants. In addition, even to achieve a minimum level of LEED (Leadership in Energy and Environmental Design) certification (silver) for sustainable warehouse, energy and atmosphere efficiency is a vital factor (An and Pivo 2018). Although the use of environmentally-friendly energy sources in warehouse is another scored factor for environmental warehouse in LEED certification (An and Pivo 2018), this environmental activity is considered in the environmental infrastructure, sources and design which is indicated before. Moreover, a suitable layout of warehousing and easy access can reduce storage and retrieval delays (Wu & Dunn 1995; Liu et al., 2017) and reduction in delay time can increase market share, customer satisfaction and profitability (Liu et al., 2017; Prakash and Pathak 2017). The use of energy-efficient refrigerants can benefit companies by increased cost savings which may result in improved revenue (Zainuddin et al. 2017). Therefore, efficient storage of goods and the use of energy efficient refrigerants are included in the conceptual framework and investigation of this study due to their importance as well as being highly cited in the literature.

3.5.5 Recycling and reverse logistics

There are several environmental activities of recycling such as monitoring recycling of transporting waste, recycling containers and other packaging materials of logistics which are proposed by Zhang et al. (2014). These activities are useful for improving environmental efficiency via disposal mitigation. Reducing waste and recycling also benefits companies by decreasing the costs of material purchasing. Other activities are suggested by authors in this group and include dealing with hazardous materials and waste disposal (Büyüközkan and Berkol 2011; Lin & Ho 2011), recycling (Awasthi, Chauhan & Goyal 2010) and waste control and treatment (Lam & Dai 2015). These can bring about the same benefits such as increased cost savings and reduced material usage for companies. Using recycled paper and encouraging reuse and recycling plus solid waste logistics management (Bing et al. 2016) are also relevant activities under the title of recycling and reverse logistics. Although recycling and reverse logistics are more appropriate for manufacturing companies, logistics companies can also benefit from this type of activity to improve their environmental efficiency and financial performance. Therefore, waste control and recycling packaging material are activities improving company's performance through reducing costs and enhancing company's reputation (Abduaziz et al. 2015; Graham, Graham & Holt 2018). Environmental activity adoption is one of the opportunities that improve the reputation of company from customers' viewpoints (Sanchez Rodrigues & Kumar 2019). Recycling packaging material of this group could be implemented by logistics companies as well as waste control which is the most cited environmental activities by scholars. Therefore, these activities are considered for investigation in this research study.

3.6 Benefits and necessity of environmental adoption in logistics

Environmental marketing, environmental packaging and environment-friendly distribution are some initiatives on the outbound side of the environmental supply chain which may enhance the environmental performance of a company and its supply chain (Prakash & Pathak 2017; Jurksiene & Pundziene 2016; Rao & Holt 2005). Cost savings, and improved competitiveness are the results of outbound waste management in such areas as reverse logistics and waste exchange. Environmental marketing has played an important role in the link between competitive advantage and environmental innovation (Papadas, Avlonitis & Carrigan 2017; Menon & Menon 1997) by its impact on customer relationships (Tan et al., 2015) and corporate customers on suppliers (Karna & Heiskanen 1998). Environmental marketing knowledge can act as a dynamic capability, which is founded on knowledge about the market with an environmental orientation and can lead to increasing innovation. Since innovation can create a competitive advantage for a company, environmental marketing plays an important role to achieve a competitive advantage (Papadas, Avlonitis & Carrigan 2017; Jurksiene & Pundziene 2016). Menon and Menon (1997), and Prakash and Pathak (2017) found positive effects in implementing an environment-friendly packaging scheme to increase market share. Warehousing and packaging design are paramount issues in outbound logistics and distribution, because of the suitable layout of warehousing, standardised reusable containers and easy access to information, all of which can reduce storage and retrieval delays (Wu & Dunn 1995; Liu et al., 2017).

Companies are interested in making business decisions towards the interests of their customers. Consequently, increasing a customer’s concern about sustainability can affect their decisions. Therefore, environmental orientation as a part of sustainability orientation has turned into a source of competitive advantage in recent years (Cucchiella et al. 2012; Alfalla-Luque, Machuca & Marin-Garcia 2018; Yadav, Han & Kim 2017) and customer requirements are a critical reason for an environmental orientation in logistics industries (Haleem & Khan 2017; Lieb & Lieb 2010). Leading-edge logistics service providers concentrate centrally on customer needs and are highly equipped to meet these (Haleem & Khan 2017; Kim & Lee 2012) since logistics performance is based on an elevated understanding of customer requirements and is vital for achieving success for companies as well as for the whole supply chain (Cucchiella, Koh, Walker, et al. 2012). In addition, customer demands and interests in regard to environmental initiatives in their purchasing of services has grown increasingly (Isaksson 2012). Consequently, environmental logistics industries need to implement environmental activities to offer acceptable services to their highly aware customers.

Although the implementation of environmental activities for business requires additional costs at first, tangible commercial benefits and superior profitability may result (Palmer & Truong 2017; Tan et al., 2015). Cost savings and improved revenue are two benefits of environmental adoption (Zainuddin et al. 2017; Čekanavičius, Bazytė & Dičmonaitė 2014). Thus, costs saving and increased revenue in the long term can motivate companies to adopt environmental activities, although additional costs at first may prevent them from investing further in initiatives. An increase in revenue can be the result of product differentiation, brand image, communication with customers, higher productivity and adding value (Zainuddin et al. 2017; Collins 2008; Swallow 2009), and so a business can distinguish itself by implementing environmental activities to gain a competitive advantage. In addition, customers might purchase goods and/or services for commodity, brand and image (Čekanavičius, Bazytė & Dičmonaitė 2014). Environmental brands for those businesses that target environmental consciousness create a competitive advantage by responding to an increase in brand awareness among both retail and business-to-business customers (Čekanavičius, Bazytė & Dičmonaitė 2014; Wu et al. 2018).

Since some of the overall objectives of the environmental business are a reduction in negative impacts on the environment, lower production costs and product value improvement, environmental logistics offers numerous benefits. For example, a lower inventory level is a benefit that can result in cost reduction and increased revenue. Improvement in customer service can increase customer satisfaction and bringing loyalty, which can further provide a competitive advantage for a company as a means of gaining more profitability. In addition, enhancement of the image of the corporation and information enrichment for reverse logistics are other benefits which can be attributed to environmental adoption (Aivazidou et al. 2017). For instance, an environmental corporate image can provide new market opportunities as well as growth in market share with a new form of products and the technology created

(Abdala, de Oliveira & Cezarino 2018). In this way, managing environmental logistics can affect a company's operational, economic performance and competitiveness positively in the long term (Alfalla-Luque, Machuca & Marin-Garcia 2018; Jun & Rowley 2018; Yadav, Han & Kim 2017).

Environmental implementation can also stimulate the development of innovations (Song & Yu 2018; Anwar, Khan & Khan 2018) because of a need for companies to carry out activities with an environmental orientation. In addition, environmental services offered within a company can be a potential source of revenue or cash flow for logistics service providers (Demirkesen & Ozorhon 2017; Isaksson 2012). Thus, the development of environmentally responsible, environment-friendly operations and a commitment to the natural environment have been adopted by an increasing number of Chinese companies as paramount variables within the competitive scenario (Lin & Ho 2011). There are also several examples of the development of environmentally responsibility in Australian industry such as a sustainable supply chain network design in the case of the wine industry (Varsei & Polyakovskiy 2017) and evaluating corporate environmental disclosure in the Australian mining and material industry (Lee 2017).

Investment in environmental implementation is not only environmentally-friendly but also business–friendly because it leads to an increase in business efficiency (Tan et al., 2015; Turki, Medhioub & Kallel 2017) through savings in resources, mitigation of waste and improvement in productivity (Bashir & Verma 2017; Porter & Linde 1995). Environmental activities benefit companies with sustaining the competitive advantage towards developing unique resources and providing the economic value including positive effects of environmental activities on enhancing profit margin (Yadav, Han and Kim 2017).

Moreover, an investment in environmental initiatives can lead to major competitive advantages in both operations and innovations (Kwak, Seo & Mason 2018; Song & Yu 2018; Isaksson 2012). Lieb and Lieb (2010) and Kothawade (2017) claim that the adoption of environmental initiatives such as strategic environmental sourcing and ISO for logistics service providers can act as a business opportunity to attract new customers, by offering environmental services aligned with customers' awareness and interests. Since the adoption of environmental initiatives can provide the same level of implementation for companies, a further level of environmental activity implementation can create a competitive advantage for a company who targets a competitive advantage.

There is a significant positive relationship between environmental logistics activities and performance (Graham, Graham & Holt 2018; Kim & Han 2011) since environmental activities such as carbon dioxide (CO_2) reduction, recycling promotion and energy and water conservation have a positive trade off with operational costs (Abduaziz et al. 2015; Graham, Graham & Holt 2018). Although there usually can be a slight increase in operational costs at the start of any implementation of environmental activities, a substantial reduction is achievable in energy and water consumption, CO_2 emissions and the generation of waste, with a long term reduction in the associated costs of energy, water and wastes. These initiatives aim to improve environmental performance, reduce costs, enhance the image of a company, reduce risks of non-compliance and improve marketing advantage.

Environmental performance can affect the financial performance of a company in several ways (Rao & Holt 2005; Tan et al., 2015). For instance, reuse and recycling decrease the need for material purchasing. The use of fuel-efficient vehicles and clean technologies also reduce fuel and energy consumption. Better utilisation of natural resources is another result of minimising both hazardous and non-hazardous wastes as a part of environmental management, which can also improve costs savings. Consequently, these environmental activities can lead to improved efficiency, higher productivity and reduced operating costs. Furthermore, an improvement in environmental performance go on to affect marketing advantage positively, leading to increased revenue, improved market share and new market opportunities (Abdala, de Oliveira & Cezarino 2018; Rao & Holt 2005; Tan et al., 2015). Since increased market share, new market opportunities, improved profitability and cost savings are measures of competitive advantage, it seems that improved environmental performance can provide a competitive advantage.

The Australian Government targets a reduction of around 80% of greenhouse gas emissions by 2050 relative to 2010 (Wolfram, Wiedmann & Diesendorf 2016). One of the most significant sectors of the economy that has contributed to generating carbon dioxide is logistics. A study by Bradshaw, Giam and Sodhi (2010) ranks Australia amongst the top ten worst environmental offenders worldwide. Although this rank is not merely related to logistics activities in Australia, the logistics activities contribute to high negative impacts on the environment. Jason (2012) claims that Australia is already well known as the world’s biggest greenhouse gas emitter per capita and that a new study on broader environmental damage shows Australia is continuing to fall behind. According to the Guardian (2018), Australia’s greenhouse gas emissions are rising by1.6% in the last quarter and 1% in the past year which is the highest figures seen in years. In addition, Australia's carbon emissions are again the highest on record, according to new data from the emissions-tracking organisation Ndevr Environmental which replicates the federal government's national greenhouse gas inventory (NGGI) quarterly reports (The Guardian 2018). Australia, as a developed country, needs to have a commitment to corporate social responsibility (Grayson & Hodges 2017).

Australia has many ports; thus, the logistics industry is one of the significant sectors contributes to Australia's economy. Low-cost transport allows Australian exporters to reach profitability in key markets and benefits, Australian manufacturers, to keep cost-competitive. Every industry in Australia depends on logistics and transport (Council 2014). Thus, the logistics industry is the pivotal section of Australian business which is significantly used in this country and enhances the nation's productivity (Council 2014). Moreover, the logistics industry is able to play a vital role in decreasing the carbon footprint and emissions by implementing environmental activities and considering sustainability as a part of their strategies (Kim & Han 2011). Therefore, according to the literature, the logistics industry with adopting environmental activities not only helps Australia in the reduction of pollution, but also can be a source of huge benefits for businesses.

The logistics industry is of high importance because they play a vital role within supply chains through offering logistics services such as distribution, warehousing and loading freight. According to the Australian Logistics Council (2016), logistics companies contributed approximately 8.6% of the nation's gross domestic product

(GDP*)* in 2013 and they contributed around $131.6 billion to Australia's economy in that same year. According to the Australian Bureau of Statistics (2018), total transport activity contributed $122.3 billion to Australia's GDP in 2015-2016. "The transport industry alone made a notable contribution accounting for $77.0 billion (4.6 per cent) of GDP in 2015-16." In addition, more than 1.2 million people are employers and employees in Australian logistics companies, which provide vital services to the top four industries by value, including mining (9.6%), construction (7.4%) and manufacturing (7.4%) (Australian Logistics Council 2016). Since a 1% efficiency improvement of the sector can lead to generating $2 billion dollars of gains to the economy per year, the logistics industries are important for the enhancement of efficiency (Australian Logistics Council 2016).

3.7 Conceptual framework

Based on the discussion in this chapter arguing the effects of environmental adoption on improving sustainable performance, the conceptual framework of this research study has been developed to investigate the effects of the adoption of environmental activities on sustainable performance for logistics companies. The framework is divided into three parts based on the research questions of this thesis. Firstly, there are several influencing factors discovered in the literature that affect the adoption of environmental activities by logistics companies. There are several environmental activities which can be applied by logistics companies, which are summarised in eight distinct groups. By such means, logistics companies can reconfigure their activities with an environmental orientation to create differentiation and cost savings which are two ways to provide a competitive advantage through improving the sustainable performance, as per Porter' theory (1985).

The measures of performance are set in the third part of the conceptual framework based on three dimensions of sustainability which were explained previously in Table 2.1 in Chapter 2 and their definitions are explained in Appendix N. In addition, there are dyadic measures such as customer satisfaction with social and economic dimensions as well as the environmental image of a company as a measure with triad dimensions are excluded to decrease ambiguity. There is a backwards vector from sustainable performance part to the influencing factors in the conceptual framework.

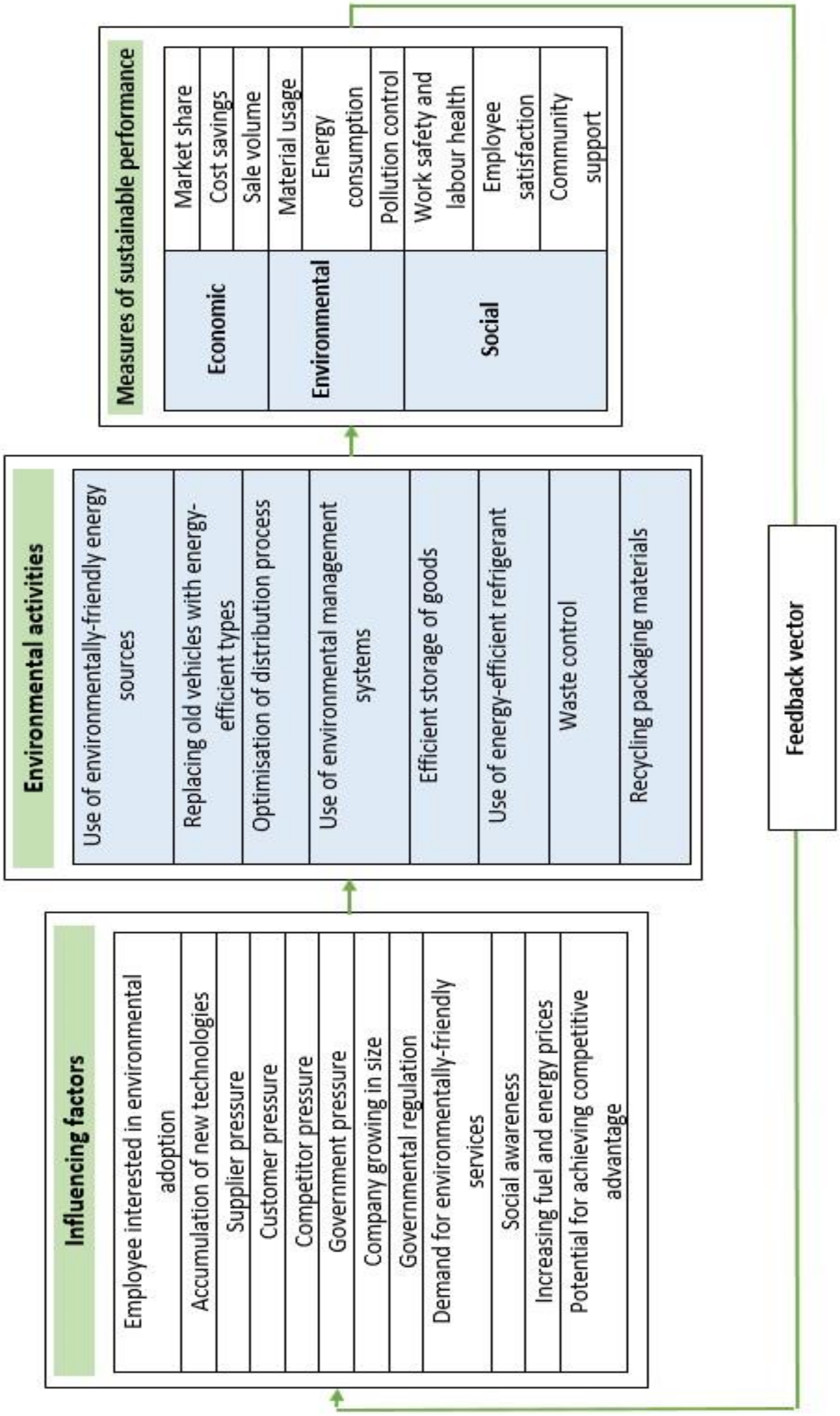

Figure 3. 2 Conceptual framework of the thesis

To be an environmental leader, market competitiveness, the exploitation of market opportunities and an increasing market share can motivate companies to implement environmental activities (Abdala, de Oliveira & Cezarino 2018; Isaksson 2012; Salomone 2008). Performance improvement is a means to achieve a competitive advantage. In addition, market share and new market opportunities are measures of competitive advantage (Ahi & Searcy 2015; Sigalas & Pekka Economou 2013). Based on the literature, achieving competitive advantage can act as an influencing factor; and therefore, the improved measure of sustainable performance can act as an influencing factor to environmental adoption that will be investigated in this study.

3.8 Summary

Recently, increasing awareness about sustainability has begun to put pressure on companies to adopt environmental activities. Companies can adopt these activities to make their businesses more environmentally oriented. Environmental adoption can have benefits for both the environment and for the companies. Since negative impacts are produced by transportation, environmental logistics can play a significant role in protecting the environment. There are several types of environmental activities based on logistics functions. A wide variety of services are offered by logistics companies to service buyers. Thus, logistics companies can improve sustainable performance through adoption of these activities. Since improved efficiency can provide a competitive advantage, it seems that efficient environmental activities can improve sustainable performance for logistics companies. The conceptual framework of this thesis will assist in the investigation of the effects of the adoption of environmental activities on improving sustainable performance. The next chapter will introduce the research methodology chosen to investigate the research question.

CHAPTER FOUR: METHODOLOGY

4.1 Introduction

The literature review found that implementing environmental activities has positive effects on the environment, but the benefits of implementing these activities for logistics companies needs to be investigated. The literature such as Lam and Dai (2015), Zhang et al. (2014) and Giacomo, Guthrie and Farneti (2017) suggests that logistics companies can make their business environmentally-friendly through the use of eight types of environmental activities such as the use of environmentally-friendly energy sources and optimisation of the distribution process. These activities not only decrease the negative impacts on the environment, but they also provide companies with some advantages. The effects of implementing these activities on improving sustainable performance will be investigated by using the conceptual framework of this study developed in Chapter Three. In this regard, the measures of sustainable performance are used to investigate this relationship between implementing these activities and improving sustainable performance. An additional finding is that there are several factors that can influence logistics companies to implement environmental activities; however, these factors have not been evaluated or ranked in previous studies. Appropriate research design and methodology are needed to investigate the conceptual framework empirically. Therefore, this chapter provides a detailed description of both the research design and the methodology. The chapter also explains the choice of a quantitative method and the web-based survey used to collect data from senior managers of Australian logistics companies. In addition, the methods of preparing the survey instrument, pre-testing and administrating the survey are discussed, as well as error-control processes, validity and reliability.

4.2 Research philosophy

The logical foundation of the research study is the methodological strategy that attempts to answer the research questions and anticipate the process of data analysis simultaneously (Mason 2006; Denzin 2017). The overall approach taken, the theoretical base of the researcher, and the method of data collection and analysis are components of a research methodology (Kaplan 2004; Denzin 2017). In scientific research, the foundations of the research are provided by philosophy. However, in social science, problems may arise as a result of complexities, and scholars need to seek guidance from the academic discipline of philosophy, where various ideas and arguments can benefit scholars in solving the issues (Benton & Craib 2010). They help scholars in understanding and explaining the world because the ability to systematically identify and analyse problems is one of the great strengths of the social sciences (Dash 2015).

There are four main research philosophies within the scope of business studies (pragmatism, positivism, realism and interpretivism) which are discussed by scholars such as Collis and Hussey (2013) and Weijun (2008). Since positivist research uses scientific methods of enquiry to obtain knowledge in a world which is objective (Wilson 2014), this study chooses a positivist philosophy. In addition, experiments and surveys where quantitative data is the norm are the methods associated with this paradigm and, along with verified data (positive facts) received from the senses, these are known as empirical evidence (Collis and Hussey 2013). Positivism is based on empiricism because it places emphasis on experience as a valid source of knowledge and positivist epistemology assumes that legitimate knowledge claims are only made by the facts derived from the scientific method (Dash 2015). In other words, positivism is in accordance with the empiricist view that knowledge stems from human experience.

This research investigates the conceptual framework developed in Chapter Three to empirically evaluate the relationship between its factors through a deductive approach and quantitative method. Quantification helps to describe parameters and to discern the relationships between them to enhance precision essentially through systematising the knowledge generation process as per a positivist paradigm (Dash 2015). In this study, the research process utilises the positivist notions of hypothesis development and testing. Therefore, this study is a positivist study because it is based purely on perceptions and considers the world to be external and objective (Wilson 2014). As in other positivist studies, the role of the researcher remains objective and is limited to data collection and interpretation. Since the researcher in a positivist paradigm is independent of the study, the results are usually observable and quantifiable through statistical analysis (Collins 2010; Crowther & Lancaster 2008; Bernard 2017).

4.3 Research methods

There are several methods to conduct research, and these vary according to whether they collect qualitative data, quantitative data, or both (mixed methods) (Weijun 2008; Bernard 2017). As well as making a choice between qualitative, quantitative and mixed methods, researchers must make important decisions on the required depth of questions, the amount of data and the length of personal comments in each survey as well as consider the response rate, the number of questions and return times from respondents (Bernard 2017; Bettis et al. 2014). Quantifying attitudes, opinions, behaviours, and other defined variables and generalising results from a larger sample population are outcomes of quantitative methods.

The quantitative methods of data collection are considerably more structured than qualitative methods and include different forms of a survey such as online surveys, mail surveys, face-to-face interviews and telephone interviews (Tuli 2011). The mixed methods approach is used and accepted in various disciplines as a valid methodological choice (Creswell 2013), and any bias resulting from subjective interpretation of the data can be potentially reduced by quantitative research (Creswell & Clark 2011). However, this study does not use the mixed methods approach because it is a method, which is appropriate for research questions that place emphasis on processes, outcomes and understanding group (Creswell 2013) whereas this research study attempts to investigate the relationships between distinctive items in the literature. Moreover, quantitative methods have tended to be dominant in the strategic management field (Molina-Azorín 2009; Molina-Azorin 2015). Therefore, a quantitative method is more appropriate in the logistics management field as well as for answering the research questions of this study. The research questions of this study start with 'does' and 'what' to investigate the effects and the relationship among determined components of the conceptual framework of this study. This study does not seek a process and does not use 'how' in research questions. Thus, this study uses the quantitative method with a quantitative focus and using mostly close-ended questions. There are some limited open-ended questions used to find possible new factors such as influencing environmental adoption or new environmental activities implemented by logistics companies in the last five years.

Researchers can choose from several approaches to collect data, based on their objectives, such as a survey or a case study (Thornhill 2008; Denzin 2017). If the researcher's aim is to examine a factor in depth and with great detail, then a case study is an appropriate approach for eliciting outcomes or generating and examining a formula or method (Yin 2011). However, a survey with a high response rate allows for the generalisation of results from a sample population to a larger target population (Leggett 2017). In a survey, the data are collected from a sample of a pre-defined group of respondents to gain information and insights on the topic (McGuirk & O'Neill 2016). When the population of interest is large or diffused across a large geographic area, the survey is a time and cost-effective method for scholars (Koh et al. 2017; Leggett 2017) because it can decrease several costs such as transportation and travel. The survey is flexible because it can be administered in many modes such as online surveys or email surveys with a low cost (Brace 2018). In addition, the anonymity of surveys allows respondents to answer with more candid and valid answers (McGuirk & O'Neill 2016). The survey is useful in describing the characteristics of a large population (Koh et al. 2017). Furthermore, answering a survey can be done whenever the respondents have time, even on holidays or a weekend and it is not limited to work time. Thus, the survey helps the respondents with flexible time to answer, which can increase the response rate. Therefore, using a survey can be an appropriate method for this study because this research investigates a number of logistics companies across seven states of Australia. Since having access to numerous managers for other methods such as face to face or telephone interview can be expensive and the population of interest in this study is large and diffused across a vast geographic area, survey sampling can be especially useful and cost-effective for researchers (Koh et al. 2017; Leggett 2017). Moreover, the use of a survey can help the study to better collect data because the respondents can easily engage in the survey by clicking a link and quickly enter their responses by ticking the boxes. Surveys can also be categorised based on the period of study. Therefore, collecting data from respondents is conducted in a single period of time (Barros & Hirakata 2003; Ferguson et al. 2015).

4.4 Research design

After selecting the method of data collection, there is a need to choose the research population, sample and sampling frame to conduct the survey and collect the data. Chapter Three emphasised the role of implementing environmental activities, in particular, protecting the environment as well as making benefits for companies. This research investigates the effects of adopting environmental activities to improve sustainable performance. Thus, for data collection, the researcher needs to choose companies that can decrease the negative impact on the environment by implementing environmental activities.

Figure 4.1 illustrates the process followed in this study to collect data. Chapter 2 and Chapter 3 provided the background examination of this study via a comprehensive review of the literature. The first step (shown in yellow) shows the literature review, the first step of the research study, on sustainable performance, environmental activities in logistics as well as drivers of environmental adoption with relevant chapters. The second step (shown in pink) illustrates that the literature review has led to developing the conceptual framework which is discussed in Chapter Three. The other parts of the figure (shown in green and blue) show that the next step is providing a questionnaire as well as conducting a survey to collect data which are explained in this Chapter.

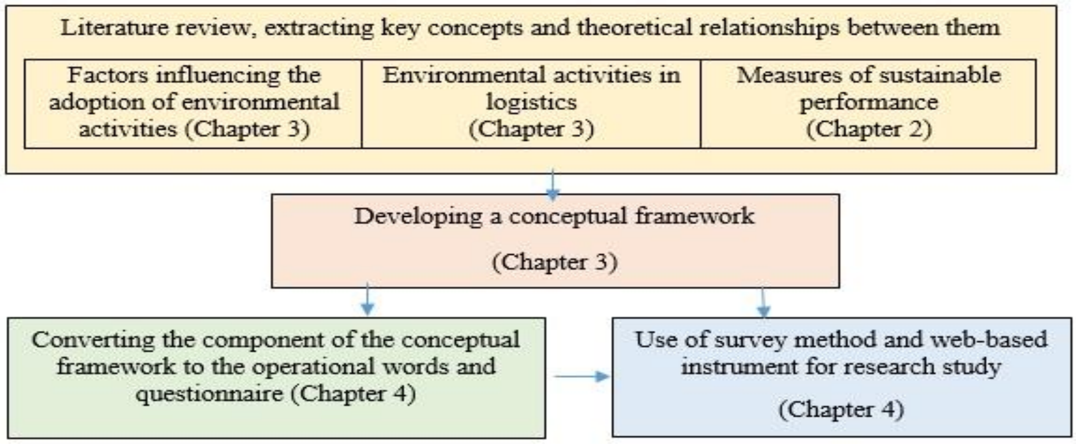

Figure 4.1 Research study's process to collect data

4.4.1 Research sample and sampling frame

This study investigates the effects of adopting environmental activities to improve sustainable performance and making benefits for companies. Since logistics is one of the significant sectors that impact on the environment such as air emissions and noise (Altuntaş & Tuna 2013; Lam & Dai 2015), it has the potential to decrease negative impacts on the environment with the adoption of environmental-related activities. The importance of environmental issues which is related to the context of this study is one of the important reasons for choosing logistics companies as the sample. In addition, as discussed in Chapter Three, environmental activities in logistics have the potential to create benefits for companies. Thus, the effects of implementing eight types of environmental activities on improving sustainable performance are evaluated in the context of this study. Therefore, this research study will draw its sample from Australian logistics companies.

4.4.2 The population of this study

The population of this study is the total number of logistics companies in Australia. The population was calculated through the use of several databases. To calculate the population, this research used Company360's database on the library website of the University of Tasmania. This database includes the number and the name of approximately all companies from several types of business. In addition, an email was sent to the office of the Australian Federation of International Forwarders (AFIF) to seek assistance in developing a list of Australian freight forwarders. The list of Australian freight forwarders provided by AFIF included logistics companies that offer only freight forwarding services. Since this study considered all logistics companies with several services, to prevent the list from missing the other logistics companies, the following websites were also checked:

- Supply Chain and Logistics Association of Australia (http://sclaa.com.au/)
- Australian Logistics Council (www.austlogistics.com.au)
- Directory of Australian logistics companies

  (http://www.logisticslist.com/australia-logistics-companies.html)
- Australian National Transport (http://www.arslogistics.com.au/)
- Logistics Australia (http://www.logisticsaustralia.org/)
- Australian Freight & Logistics Directory

  (http://www.australianfreightandlogisticsdirectory.com.au/)

- Yellow pages (https://www.yellowpages.com.au); and
- White Pages (https://www.whitepages.com.au)

The total population extracted from the above lists is 1293 logistics companies after removing repetitions. Since Australia is a vast country and having access to all members of the large population is difficult, the most appropriate strategy for collecting data is random sampling because this technique provides an equal and known chance of selection by each member of the population when it is often difficult or impossible to identify every member of the population and there is large population across an extensive geographic area (Leggett 2017).

Random sampling is used because it is the most appropriate form of probability sampling and generalisation is gained through statistical probability and sampling with random selection (Easterby-Smith, Thorpe & Jackson 2012). Thus, an equal and known chance of being selected by each member of the population is the feature of this sampling strategy. When it is often difficult or impossible to identify every member of the population and there are very large populations, an appropriate strategy can be random sampling to decrease bias (Sen & Singer 2017). Since this study is collecting data from Australian logistics companies from all Australian States and access to all members of this large population is challenging, time and cost consuming, the most appropriate strategy is a random sampling. Since the target population of this research is finite, Table 4.1 developed by Krejcie and Morgan (1970) is used to determine the sample size.

Table 4. 1 Sampling size based on Morgan method

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Source: Adapted from Krejcie and Morgan (1970, p.608)

To simplify the process of determining the sample size for a finite population, Krejcie and Morgan (1970) generate a table using a sample size formula for the finite population (Wijewardene, SMF & Khatibi 2018). Thus, this research applies a 95% confidential level and 5% margin of error for the targeted population, which makes a reasonable balance between the cost of collecting data and the value of the result. The sampling size is determined based on the Krejcie and Morgan (1970) sampling method (Table 4.1) that is used in several empirical studies such as Kianpour, Jusoh and Asghari (2014) involving a confidence level of 95 percent with a margin error of 5 percent. Since the total population is 1293 logistics companies, the sample size is 297.

4.4.3 Unit of analysis

One of the most important components of the research design process is determining the most appropriate unit of analysis (Sekaran & Bougie 2016). The unit of analysis is the major entity that is being analysed in a study and in social science research, typical units of analysis include individuals, groups, social organisations and social objects (Jarzabkowski & Kaplan 2015). In this research study, the unit of analysis is an individual from Australian logistics company. Senior managers sampled in all States of Australia are invited to participate in this study. Senior managers within the sample are recruited because they can provide enriched responses about a wide range of issues such as the company's history, services and activities, as well as plans and policies (Marshall & Rossman 2014; Pateman 2015). Their knowledge and experiences in terms of decision-making and developing strategies in a sustainability context can benefit this study and address the research questions. Senior managers are usually knowledgeable about external issues such as the business environment, current and potential competitors and government regulations as well as internal issues such as employees and financial performance because they receive the reports from middle and senior managers (Jarzabkowski & Kaplan 2015; Sarens & De Beelde 2006).

This research targets the chief executive officer (for large companies) or managing director/operational manager (for small companies) as the first priority. However, as some companies may not have the position of chief executive manager or in the case of a lack of accessibility to these two positions, other positions related to logistics management will be the next priorities. These positions may include logistics managers, account managers, and general managers since it is assumed they should have sufficient information about the environmental activities of their companies to answer the questionnaire.

4.5 Data collection

An important decision is how best to approach the senior managers to gain relevant information (Harvey 2011). Therefore, a web-based survey can be useful to collect data from them because they can easily access the survey by clicking a link whenever and wherever they are even through using their mobile phone. The web-based survey is useful for managers with a lack of time. Each survey method has its own advantages and disadvantages. The probability of obtaining sufficient valid and reliable data depends on choosing an appropriate instrument design. Thus, understanding the advantages and disadvantages of different types of survey can facilitate the selection of the one most appropriate.

Some challenges such as the issue of accessibility, login procedure, web navigation and troubleshooting may decrease the response rate in web-based surveys (Guo et al. 2016). Sample frame and non-response bias are the most commonly cited disadvantages of web-based surveys (Tijdens, 2016; Fleming & Bowden 2009; Li, Stuart & Allison 2015). The researcher often has no way of discerning issues and it is another potential disadvantage of web-based surveys, especially when several respondents are at one computer address (Fleming & Bowden 2009; Callegaro, Manfreda & Vehovar 2015). The absence of the interviewer and inability to reach a challenging population can be other demerits of web-based surveys that are suggested by scholars such as Tijdens (2016), Lahtinen, Ala-Mutka and Järvinen (2005), and Callegaro, Manfreda and Vehovar (2015).

However, web-based surveys present advantages such as reduced cost, convenience, geographic access and improved timeliness when compared to mail surveys (Guo et al. 2016). Web-based surveys can be effective due to improving the user-friendliness aspect of the participant experience such as ease of login and adopting a professional interface including logos of credible organisations (Guo et al. 2016). The web-based survey is more appropriate when the sample size is large, and the analysis of the results is on a broad basis (Callegaro, Manfreda & Vehovar 2015; Groves et al. 2011) because it allows the researcher to collect and analyse the data from a large sample size quickly in SPSS format or Excel format which is ready to enter to SPSS software. The web-based survey enables data collecting from large sample sizes at a comparatively low cost and provides increased potential for sub-group analysis and decreased sampling variance (Fleming & Bowden 2009; Callegaro, Manfreda & Vehovar 2015; Tijdens 2016). Thus, only a little maintenance work is necessary for collecting and processing the data after programming which can decrease the need for human labour and reduce back-end costs (Durrant & Dorius 2007; Kontu et al. 2015) compared to a traditional copy questionnaire which needs to enter the results manually. Therefore, the most commonly cited advantage of the web-based survey is cost saving which is indicated by some scholars such as Fleming and Bowden (2009) and Tillier et al. (2015). This advantage is very useful in this study because the data is collected from the several States of Australia.

Convenience and reliability of the survey are vital factors that are advantages of the web-based survey (Callegaro, Manfreda & Vehovar 2015; Groves et al. 2011). The web-based surveys benefit researchers by collecting data continuously, regardless of the time of day and day of the week, and without geographical limitation (Fleming & Bowden 2009; Callegaro, Manfreda & Vehovar 2015). Thus, studies with a diffused sample can use the web-based survey to overcome the difficulties of collecting data in a short period of time which may be necessary due to economic constraints. The speed and accuracy of data collection are other often-cited advantages of web-based surveys (Greaves et al. 2010) because they can easily be completed, and the researcher can access the results quickly.

4.5.1 Designing the web-based survey

The web-based questionnaire provides an opportunity to insert responses into spreadsheets, databases or statistical packages automatically (Fleming & Bowden 2009; Jones 2017). Further reduction in respondent completion time is another advantage of the web-based survey because the respondents directly enter their own opinion. The web-based survey benefits researchers by eliminating the administration processes of sending out and collecting the survey via e-mail (McPeake, Bateson & O'Neill 2014). Direct data transferral results in time-saving and reduces human error in data entry and coding. The web-based survey is one of the most flexible and easiest back-end data processing types of survey (Callegaro, Manfreda & Vehovar 2015; McPeake, Bateson & O'Neill 2014).

Since the web-based survey has the capacity to design innovative questionnaires that incorporate visual stimuli (Tijdens 2016; Fleming & Bowden 2009; Jones 2017), researchers can use this feature to encourage respondents and potentially increase the response rate. For example, researchers can create colourful pages with an attractive theme (Fleming & Bowden 2009) which increases the attention of respondents. This capacity of the survey may increase the response rate and the accuracy of data because the chance of errors and availability of resources are other important elements to consider when choosing the type of survey (Durrant & Dorius 2007; Jones 2017).

As discussed, several elements should be considered when selecting the type of survey, and these include the size of the population, time, data quality, cost and administration (Callegaro, Manfreda & Vehovar 2015). In summary, this study chooses a web-based survey because of several reasons. Firstly, the research sample is large and the units of analysis are senior managers. When the target respondents are senior managers, the web-based questionnaire is a more flexible means through which to respond because the senior managers are busy (Dillman 2011). Thus, the opportunity to respond at any time may encourage them and lead to an increased response rate. Secondly, web-based questionnaires are also being used increasingly in business research as a data collection method. In addition, recently, the web-based questionnaire has become considerably used because of its advantages such as cost-efficient, quick data collection, easy transferring of data and reduction in total survey error. Logistics companies in Australia are spread over a wide geographical area (Pateman 2015). The web-based questionnaire may reduce costs related to accommodation and air flight as well as providing the opportunity to access logistics managers all over Australia without the researcher having to travel. Lastly, the web-based survey saves time compared to sending out hard copy questionnaires by mail. Although there are some risks associated with the web-based survey such as low response rates and non-committal responses, the advantages far outweigh its disadvantages. The lack of trust may cause sample bias because the only respondents who trust online surveys may participate. However, there are some appropriate strategies to build trust online that can minimise the risk of sample bias. For example, providing valuable, reliable and insightful content attached in two-way e-communication, sharing trustworthy links of trustable survey websites, and informing the respondents about the researchers and the aim of survey in the invitation email and participant information sheet, can increase trust and decrease sample bias (Fan & Lederman 2018). The risk of low response rates will be mitigated by using two reminders and the commitment for keeping data confidential. Therefore, this study uses a web-based survey for collecting data from respondents.

4.6 Designing and administrating the web-based instrument

To fully maximise the effects of survey design on the response rate, researchers need to accommodate and adapt by choosing the most appropriate method of the survey to correctly manage the ever-changing attitudes toward survey participation, the social environment and technology (Guo et al. 2016). Designing the appropriate instrument plays a vital role in collecting data (Leggett 2017) because using an appropriate instrument is one of the factors that provide accurate data collection which is essential to maintaining the integrity of research as well as reducing the likelihood of errors occurring (Lewis 2015).

The web-based questionnaire was developed on the Survey Monkey website due to several reasons such as ease of use, quality of survey templates and the ease of extracting the results at the analysis phase. This website provided several ranges of question designs as well as various types of scales for specific questions. This website helped this study to have a questionnaire including multiple choice and ranking questions with an attractive design and reasonable price.

Among other survey websites such as Zoho Survey and Question Pro which is cheaper than the Survey Monkey website. SurveyMonkey is the most popular online survey tool because it provides scholars with the potential to dig deeper into the demographics and psychographics of their target audience and collect data via real-time surveys (Bell and Waters 2014). In addition, Survey Monkey is one of the most well-known survey tools available which is often ranked highly on search engines and it is regarded as a reliable tool (Phillips 2015). Therefore, some scholars such as Gaikwad (2017) and Varela (2016) recommend the use of it as a tool to collect survey data.

4.6.1 Designing the web-based instrument

The use of close-ended questions can prevent the results from being general and vague because respondents and especially busy managers may not have enough time to complete surveys if a lot of writing is required (Pateman 2015). Generally, close-ended questions are more likely to be answered whereas respondents may leave open-ended questions blank (Leggett 2017; Krosnick 2018). In addition, the analysis of close-ended questions is quick (Krosnick 2018; Krosnick & Presser 2010). Since the focus of this study is on a quantitative approach, the majority of questions in the questionnaire of this study are close-ended.

Qualitative research more uses open-ended questions within telephone or face to face interview. Although the open-ended questions increase the risk of non-responses (Leggett 2017; Krosnick 2018), the presence of a scholar or interviewer can motivate respondents to answer. Thus, the use of open-ended questions is more appropriate for a qualitative approach with interviews. The use of close-ended questions may mitigate the risk of non-responses and increase the response rate. Although in some cases the results and comments of open-ended questions may be too vague or over-generalised instead of being meaningful (Durrant & Dorius 2007; Krosnick 2018), this study uses two open-ended questions to find new implemented environmental activities and influencing factors. The option of ‘other’ is used for some close-ended questions that helps the survey to find new environmental energy sources used in Australia and new factors influencing environmental adoption.

This study uses the quantitative approach using a web-based survey because it asks the perception of managers and investigates the effects and the relationships among determined components of the conceptual framework. The research questions of this study do not seek process, approach or components with the use of ‘how’. Conversely, they start with ‘does’ and ‘what’ to evaluate the relationship between existing components suggested from the literature. After choosing the types of questions, the next step is writing each question. Thus, they are clear and relate to a specific item in the objectives and without any ambiguity (Leggett 2017; Brace 2018).

A welcome screen page is provided as the key principle for the design of a web-based questionnaire providing the main reason and benefits of study to encourage respondents to participate (McGuirk & O'Neill 2016). Starting with demographic questions prevents the respondents from being suddenly faced with more specific and challenging questions, which may increase the chance of having to deal with non-response bias. Asking demographic information at the start of the questionnaire can act as an icebreaker, encouraging the respondent to commit and continue (Keifer et al. 2014). Demographic information, levels of satisfaction or selection of specific information are the most common types of closed question (Krosnick 2018; Leggett 2017). Asking sensitive demographic questions including some topics such as race or religious may lead to non-completion of the survey (Nuno & John 2015). Only one of the demographic questions of this study is sensitive, asking the annual revenue. Since some respondents may not be willing to disclose their annual revenue even though responses are kept anonymous (Findley et al. 2017), the question may still be sensitive and therefore ignored. To make this question less sensitive, this study considers the option of ‘prefer not to answer’ in the questionnaire to reduce the risk of ignorance as well as providing bands of revenue instead of asking the exact amount.

Use of leading, loaded, absolute and double-barrelled questions may decrease the validity of questionnaire while the use of clear terminology and questions to the intended respondents increases the validity (Brace 2018). Thus, in this research, each question has been designed to evaluate only one aspect of items and avoid multi-part questions with overlapping choices such as double-barrelled questions. Another important factor is to set a non-threatening tone to make the respondents feel comfortable and at ease so that they respond to the survey questions honestly (Leggett 2017). Since the sequencing of the questionnaire affects the rate of responding positively, it is imperative to start from easy and progress to difficult questions (Krosnick 2018). Another general approach is to set the questions based on topic and sequencing logic because the logical flow of the questionnaire persuades respondents to continue and complete the questions. Thus, this research design divides the questionnaire into six total sections. After the demographic section, the rest of the questionnaire divides into five sections based on topic and sections of the conceptual framework for more clarification. The effects of implementing eight types of environmental activities (the middle section of the conceptual framework) on improving sustainable performance (the right side of the conceptual framework) are evaluated in the first, second and third sections of the questionnaire. Table 4.2 shows the summary of the questionnaire.

Table 4. 2 Summary of the question type

Section	Focus	Sections of the conceptual framework	Survey questions	Number and type of question in the questionnaire
1	Demographic features of respondents	-	1–6	6 quantitative questions 3 open-ended questions
2	The economic advantage of implementing environmental activities in logistics	The relationship between eight activities in the middle and first three measures on the right side of the conceptual framework	7–14	8 quantitative questions All are Likert: five-scale
3	Environmental advantages of implementing environmental activities	The relationship between eight activities in the middle and second three measures on the right side of the conceptual framework	15–22	8 quantitative questions All are Likert: five-scale
4	Social advantages of implementing environmental activities	The relationship between eight activities in the middle and the last three measures on the right side of the conceptual framework	23–30	8 quantitative questions All are Likert: five-scale
5	Factors influencing the adoption of environmental activities (12 factors)	Twelve factors on the left side of the conceptual framework and feedback vector	31	1quantitative question Likert: five-scale
		Twelve factors on the left side of the conceptual framework and feedback vector	32	1 ranking question
		The left side of the conceptual framework	33	1 qualitative open-ended
6	Other environmental activities	The middle section of the conceptual framework	34	1 quantitative open-ended question
7	Pairwise comparison of measures of sustainable performance	Nine measures on the right side of the conceptual framework	35–46	12 quantitative Saaty scale

The factors influencing environmental activities implementation (in the left side of the conceptual framework) as well as the feedback arrow of the conceptual framework are evaluated and ranked in the fourth section of the questionnaire because of the complexity and length of questions which may lead to non-completion of the survey by respondents if it is placed earlier. In the last section, the measures of sustainable performance (the right side of the conceptual framework) are compared with each other. Further clarity and reduced confusion can be achieved by ensuring the questions are clearly differentiated from the researcher's perspective (Cahoon 2007). Clear and consistent visual guides in a questionnaire, benefit researchers as they decrease the risk of error (Pateman 2015). In addition, ordering the questions in a logical sequence and numbering each question and page is important (Leggett 2017; Krosnick 2018) because the layout and visual appearance of the tool should be appealing and neatly organised. Therefore, in the questionnaire of this study the researcher has attempted to convert academic words and texts into the everyday operational language without losing accuracy of meaning. The most repeated environmental activities related to each activity are used instead of the name of that activity as well as considering the logical flow throughout the questionnaire.

When researchers attempt to measure an imprecise value such as belief, opinion or effect, the Likert scale is appropriate and widely used (Yusoff & Mohd-Janor 2014). In addition, the Likert-type scale is one of the existing psychometrically validated scales in the marketing and logistics literature (Hofer, Smith & Murphy 2014; Weijters, Cabooter & Schillewaert 2010). In terms of the scale length, Dolnicara et al. (2011) and Fink (2015) claim that the use of five-point or seven-point answer formats have become more popular because the percentage of scholars using five-point is approximately equal to others using seven-point. However, with regard to the length of the scale, when the number of scale points drops below five or increases to above seven, the accuracy of data becomes significantly less (Johns 2010) because the human mind can distinguish and have a span of absolute judgement to about seven distinct categories (Miller 1956) and below a five-scale does not have enough accuracy. Thus, an increase in the number of response categories beyond six or seven might be less effective (Colman, Norris & Preston 1997; Fink 2015).

Using an odd number scale is important because the use of a neutral category prevents respondents from taking a side and prevents responses from biases (Yusoff & Mohd-Janor 2014). An oddly numbered scale is chosen for this study because Leggett (2017) claims that this scale has neutral categories which has the potential to eliminate bias caused by hesitant respondents. Thus, the use of oddly numbered scales can improve the accuracy of data analysis. The ‘don’t know’ option is included in case there are some environmental activities that have not been implemented in a company or the manager does not know about the advantages of implementing them. Thus, to assist the senior managers when they are completing the questionnaire, the five-point Likert-type scale is used for each question and the ‘don’t know’ option is included.

The reliability of a test is increased from a two-point to a seven-point scale, while its unreliability is approximately equivalent when it is increased from a seven-point to an eleven-point scale (Krosnick & Presser 2010). Moreover, according to Krosnick and Presser (2010), longer scales reduce the quality of data and contain more random measurement error, and some studies claim that scales of intermediate lengths are optimal (Birkett 1986). The gain in reliability levels off after about five-points and the validity is increased from two-point to a longer scale (Krosnick & Presser 2010). According to Winter and Dodou (2010), the five-point scale appears to be less confusing and results in increased response rate and quality. Buttle (1996) and Kim, Lim and Brymer (2015) for example, also claim that the five-point scale increases the response rate. Therefore, the five-point scale is used for this research study to prevent respondents from becoming confused and to increase the response rate, validity and reliability.

A mix of both positive and negative items reduces acquiescent and extreme response biases because they help respondents to consider the question and choose a more meaningful answer (Sauro 2011). Therefore, in this survey, the choices are anchored by 1 as strongly disagree to 5 as strongly agree, including a midpoint for neither agree nor disagree which are used by some scholars (Woodcock, McGrew & Mather 2001; Ott et al. 2018) because these choices of the Likert scale are used for investigating the respondents' attitudes and perceptions (Lovelace & Brickman 2013). Reliability and validity of ratings are improved by adding midpoints to the rating scales (Krosnick & Presser 2010; O'Muircheartaigh, Krosnick & Helic 2001). Eliminating the midpoint results in inaccurate measurement and forces respondents to pick a point either on the positive or on the negative side of the scale (Krosnick & Presser 2010). Thus, the scale of this survey includes a midpoint.

Labels in the scale of this study are used to form an ordering choice because they eliminate the respondent burden and are a step away from the cognitive processes entailed in answering the question simultaneously (Krosnick & Presser 2010). Thus, labels clarify the meanings of the scale points. Leggett (2017) believes that the primacy effect influences respondents to choose the items more often on the left or at the top of a list generally. The potential for fatigue is significant after considering more than two alternatives and the respondents might tend to choose the alternatives near the beginning of a list. Thus, confirmatory bias thereby advantages the earlier items (Krosnick & Presser 2010; Krosnick 2018). Although mixing the ordering of choices (minor to major or vice versa) depending on the length of the survey is an appropriate approach to avoid bias, the change of ordering the choices may lead to confusing respondents who keep the first pattern in their mind. Thus, this study keeps the ordering of choices without any change and arranges them from very low to very high. Some respondents such as Weng (2000), believe that there is not any difference between using low to high or high to low in terms of scale order and response order had no substantial influence on participant responses and scale characteristic. It showed that response order even did not affect scale means, interitem correlations, interitem covariances, factor pattern coefficients, and inter factor covariance of the scale (Weng 2000).

However, other such as Bradburn, Sudman, and Wansink (2004) and Yan and Keusch (2015) suggest that a better general rule to follow is starting with the end of the scale which shows the least desirable. When response categories represent a progression between a lower level of response and a higher one, it is usually better to list responses from the lower level to the higher level and from left to right. In addition, the above researchers recommend starting with the end of a scale that is least socially desirable (Bradburn, Sudman, & Wansink 2004; Yan & Keusch 2015). Since the survey questions ask about improvement and important which are positive, the least desirable point for scale is strongly disagree. Therefore, the scale order from low to high is used.

Long questionnaires may result in a decrease in response as well as produce lower-quality data (Guo et al. 2016) while short questionnaires have more chance of being completed because the reduced response and completion rates occur for the survey significantly by each additional page (Leggett 2017; Krosnick 2018). Guo et al. (2016) found in their study that a 12% increased rate of response is associated with a shorter survey length based on the results from previous studies. Although a short questionnaire receives a higher response rate, covering all sections of the conceptual framework is important. Therefore, this study attempts to design a questionnaire as short as possible by asking 46 questions for achieving an improved survey response, without losing any section of the conceptual framework.

Since one of the research questions of this study asks for finding the most important environmental activity to implement from the viewpoint of the logistics manager, this study needs to have some criteria to evaluate these activities. To understand the importance of each criterion to compare with other criteria, AHP is the most appropriate method because AHP is generally used to evaluate the importance amongst criteria based on the concept of paired comparison (Yazdani et al. 2017; Baudry, Macharis & Vallée 2018). Some scholars such as Wessely and Hofmann (2014) use AHP in a survey for determining the improvements of the revenue contribution of logistics customer services. Zailani et al. (2017) also use AHP in a survey for assessing the influential factors and performance of logistics outsourcing practices. Thus, a pairwise comparison of the AHP method helps this study to extract the importance or preference weight of each criterion (the measure of sustainable performance in this study) to rank alternatives (environmental activities in this study).

In terms of pairwise comparing of the measures of sustainable performance, this study uses an analytic hierarchy process (AHP) method, developed by Saaty in 1977 (Saaty

2004; Baudry, Macharis & Vallée 2018). AHP is generally used to evaluate the importance amongst criteria based on the concept of paired comparison (Yazdani et al. 2017; Baudry, Macharis & Vallée 2018). AHP and its scale is the most appropriate tool in this part of the questionnaire because this study will extract and quantify the importance of each measure of sustainable performance from the senior managers' perspective. Twelve questions are asked in this part of the study to compare the importance of criteria instead of the use of a pairwise matrix because the Survey Monkey website is not able to design this type of matrix on the web-based questionnaire.

Since AHP is considered to be a suitable and reliable tool for developing a targeted model in the context of decision-making, the Saaty scale is used for pairwise comparison. Each question asks the importance of one measure of sustainable performance by comparing to another measure. The average importance score of each measure is extracted and set in a matrix to analyse by the AHP method. The Saaty scale includes 1 (equal importance), 3 (slightly more important), 5 (moderately more important), 7 (very much more important) and 9 (extremely more important) as well as their reverse numbers. This scale has been used by several scholars such as Dweiri et al. (2016) for supplier selection in the automotive industry and Yazdani et al. (2017) for decision making in logistics and supply chain management.

Some scholars such as Lirn et al. (2015) and Hossain, Adnan and Hasin (2014) use a Likert scale to form the AHP matrix and suggest there should practically be no problem, provided researchers ensure that the pairwise comparisons are consistent. They claim that since the scale is commonly between questions of pairwise comparison, there is not any error in terms of scale type. However, using a smaller scale (1-5) can make judgments less precise and thus more difficult (Franek 2014) because a smaller scale has not enough potential to show the differences among criteria very clear. When the scale is wider, the scores of criteria are extended in a wider range with the more clarified difference and recognising the importance of each criterion could be more accurate. Therefore, the Saaty scale (1-3-5-7-9) is used in this part of the questionnaire of this study because the final mean and weight could be various from one to nine including fractional numbers up to three digits. This scale is used to carefully rank the measures based on their importance weight. Pairwise comparison is the most appropriate method because this method can distinguish the eigenvector of each alternative by comparing alternatives and normalising their score while scoring or ranking merely shows the importance of each alternative without comparing with others. The words in the pairwise questions are presented in the same font and size to avoid designing leading questions and to remove any bias, while the titles of environmental activities in some sections of the questionnaire are typed in ‘bold’ to increase clarity for respondents. Some scholars such as O'Rourke (2001); and McGuirk and O'Neill (2016) claim that use of capital letters, bold, italic or underlined words can be used to highlight keywords in questionnaires to increase the clarity for respondents as well as their accuracy to answer.

There are several features of a company to measure by demographic questions. Industry, the size range of employment and annual revenue size range are factors that define the size of the company in Australia (Swanepoel & Harrison 2015). For example, Australian companies are divided into four business groups based on size, which is defined by features such as employee number and annual revenue. The number of employees and annual revenue are therefore two factors that indicate the size of a company (Swanepoel & Harrison 2015) and are used in this research study as demographic questions because this study can analyse the relationship between the answers from the respondent based on these demographic factors. It may reveal the effects of the amount of annual revenue and the number of employees on the investigated components of the conceptual framework of this study. Another demographic question is designed to provide data about actor type in a logistics company which is described by the number of services offered by that company according to a multi-layered service framework (Urciuoli 2010) and discussed in Chapter Three.

A small business is viewed as having a business revenue of less than $10 million at the end of the financial year (Australian Securities and Investments Commission (ASIC) 2016) which is between $2 and $25 million per annum (Australian Taxation Office 2015; Australian Bureau of Statistics 2014) and has fewer than 50 employees (Swanepoel & Harrison 2015). However, large businesses have 200 or more employees and the consolidated revenue for the financial year of the company and any entities it controls is $250 million or more (ASIC 2016; The Australian Taxation Office 2015). According to Swanepoel and Harrison (2015) and the Australian Bureau of Statistics (2016), medium companies have 20 to 199 employees (medium enterprise) and annual revenue between the revenue of small and large companies (over $10 million to less than $250 million) per year. A micro business has four or fewer employees and total business revenue of less than $2 million (Australian Taxation Office 2015).

For a better comparison, there is a need to break the groups of employee numbers down. Thus, the employees are divided into seven groups, namely 1–4, 5–19, 20–49, 50–99, 100–149, 150–199 and 200 or more employees. Once the survey data is collected, the data can be divided into various data groups based on demographic information gathered from the survey to have more discussion and analysis of responses as well as to find the differences (Smith et al. 2016).

Two questions are designed in terms of years of experience of a manager and the number of logistics services offered by a company for a better comparison of mangers' insights as well as volume and types of services. Another demographic question asks the manager to indicate their current position, such as chief executive officer, operational manager, managing director, logistics or general manager to find the effects of their positions on the collected responses. The last question of the demographic part of the survey is about the type of environmentally-friendly energy sources which a company uses to find the most uses of environmentally-energy sources and rank the rest of them (Appendix G).

4.6.2 Pre-testing the web-based instrument

Researchers need to test the questionnaire with a small number of individuals before deploying the final tool, ideally with individuals who are chosen from the intended sample (Leggett 2017). Issues such as poor question wording, unclear instructions and lack of understanding of the questions can be solved by completing the survey and providing feedback (Krosnick 2018) because respondents' answers can reveal the complexity of questions to understand. Therefore, conducting a pre-test, especially, by using a group of expert and academic lecturers is a valuable strategy to increase the validity and the quality of the instrument. The feedback from experts and academics reveals the weaknesses of the questionnaire and their suggestions can enhance the understanding of target respondents. Consequently, the validity of answers and the response rate could be improved. A pre-test of the web-based survey in this study was conducted with ten people including two selected logistics experts and eight academic lecturers in logistics management at the Australian Maritime College before the questionnaires were released. The pre-test was conducted to enhance the final version by the use of feedback for revising and refining the questionnaire (Hilton 2017) as well as to test the validity and appropriateness of the questions (Ovidiu 2015). A covering letter was provided and attached to the pre-test instrument, summarising the intention of the pre-test being to identify possible issues such as layout, logical numbering and flow, time to complete and clarity of questionnaire’s purpose, based on the checklist, which was developed by Cahoon (2004) and are provided in the Appendix D of this study. Pre-testing highlighted that some questions could be improved by changing the academic words which could confuse the respondents from the industry. The pre-test also provided some comments in terms of the structure of the questionnaire to make it easier to understand. Restructuring the questionnaire and the use of some practical words without losing the accuracy of meanings helps the study to enhance the questionnaire and collecting data with fewer errors.

4.6.3 Administration of the web-based instrument

Some scholars such as Ripper et al. (2017), claim that personalised contact with respondents reduces the perception of anonymity of the respondents and leads to a decrease in the response rate. However, this research study uses an invitation email because others such as Ward et al. (2018) believe that a personalised invitation to participate in a survey is a worthy strategy for improving the response rate. It is a motivating factor in the individual's decision to participate (Ward et al. 2018). Personalisation can consist of telephone contact, the inclusion of handwritten notes, and personalisation of the covering letter and envelope (Guo et al. 2016). The personalised invitation email, use of a coloured link and reminder contact increase the response rate in a survey (Edwards et al. 2009), which are used in this study because when the extra efforts required to personalise the researcher's correspondence are recognised by potential respondents, they may be more likely to respond. Personalisation can increase the likelihood of them responding to the survey request because according to the theory of social exchange, it reinforces respondents' self-image and, make respondents feel more important (Gendall 2005; Keusch 2015). For example, Guo et al. (2016) found a 1.9% increased rate due to the use of personalised invitation letters in their empirical survey.

In addition, to reduce the risk of the low response rate of a web-based survey, a reminder email notification has a positive effect on encouraging respondents (Kaplowitz, Hadlock & Levine 2004; Van Mol 2017). Repeated contacts with respondents affect the overall response rate positively for both mail and web-based survey methods (Kwak & Radler 2002; Leggett 2017). Thus, two reminders, as shown in Appendix F, were sent after the first contact to increase the response rate.

4.6.4 Invitation email and ethics approval

Since fears of potential fraud, infraction of privacy or links containing computer viruses may make respondents reluctant to answer, lack of trust remains a critical issue in a web-based survey (Guo et al. 2016). To mitigate this risk, the invitation email provided respondents with the information about the researcher, the university and the relevant department. The invitation email has the potential of increasing the response rate and some researchers conducting empirical surveys have reported benefits of a 10% to 13% increased response rate as a result of this method (Pateman 2015). The invitation email, in this study including key information, provides a vital element for establishing trust and credibility (Creswell 2009) because it conveys the aim and the importance of the study to the respondents (Sarantakos 2012). To meet the ethics requirement of the University of Tasmania, the name of the researcher and supervisors, University email and contact number were included in the invitation email. The respondents were informed that the involvement in this survey is entirely voluntary and they have the right to withdraw or decline during any part of the survey. They were assured that their responses will be treated as strictly confidential, and their identity and the name of your company will be kept anonymous. A participant information sheet was attached in the invitation email for providing respondents with further information about the study (Appendix C).

Transparency of the invitation email contributes to improve the response rate (Mikecz 2012) especially when the targeted respondents are managers. Since establishing trust and gaining senior managers' agreement can be more difficult (Pateman 2015), this study incorporates an invitation email. This email is short but with effective sentences because an invitation email can have a positive effect on managers and motivate them to accept the invitation to participate in the survey. When the researcher guarantees the privacy of the research subjects and the confidentially and anonymity of the responses, the potential for deception throughout the research process is minimised

(Babbie 2013). In this study, an invitation email is sent to each senior manager, including a link to the online questionnaire to motivate them to participate and inform them about the important objectives of the study (see Appendix B).

Since conducting research in Australia is characterised by high ethical and scientific standards and the dangers to participants should have been few, the University of Tasmania has ethics requirement which must be meet by scholars. In this regard, there are some documents such as participant information sheet which must be completed and sent to respondents within the invitation email. The invitation email also includes the participant information sheet (Appendix C) and ethics approval (Appendix A) so that the managers are reassured about the confidentiality of their response. Both invitation email and ethics approval not only meet the ethics requirement of the University of Tasmania, but they can also increase the response rate by ensuring respondents about the confidential responses.

In the participant information sheet, the researcher explained the reason for invitation, the purpose of the study, the competition time of the survey and the possible benefits of engaging in the survey for respondents. The respondents were also informed there were no risks anticipated with participation in this study. They were made aware their involvement in this study is entirely voluntary and they have the right to withdraw or decline whenever they decide without any consequences. They were also informed they could also skip any question they are unwilling to answer in the online survey. They informed that all their responses and information will be treated as strictly confidential. In addition, they received contact details for the Ethics Committee of the

University of Tasmania with the ethics reference number of this study for raising any concern or complaint (Appendix C).

4.6.4.1 Sending reminders

Using reminders by email or telephone can be more effective than other incentives, (Van-dongen et al. 2013) and sending at least one reminder after distributing the questionnaire can improve the response rate (Rowley 2014). Thus, this research sent two reminders with the same content in the first and second weeks after the invitation email to follow-up the responses because the use of reminders is one of the best practices for increasing response rates to online surveys (Cook et al. 2016; Nulty 2008). The reminder email (see Appendix F) also included an expression of thanks for those who had already responded to the questionnaire and a reminder for other participants who did not respond to follow the web link to the questionnaire.

4.7 Error control process

Some errors can occur in the survey design such as sampling coverage, measurement and non-response errors (LaRose & Tsai 2014; Christian 2009). Efforts to mitigate the errors to achieve acceptable levels are a key element in the survey design (Dillman 2011). For instance, a key focus during the survey design process is error reduction, with monitoring the survey development process to minimise error at every opportunity (Pateman 2015). Therefore, in the analysis, the researcher needs to pay attention to measuring and compensating for potentially introduced errors (Singer 2006; LaRose & Tsai 2014) to increase the quality of data.

Sampling error is relevant to the selection process for obtaining the sample (Dillman 2011). In this survey, the names of companies were collected from the Australian Logistics Council, the Australian Federation of International Freight Forwarders, Company360 database, and the white pages and yellow pages of the telephone directory to provide a comprehensive list of Australian logistics companies and mitigate the risk of missing some companies. Preparing a comprehensive list of Australian logistics companies can compensate for the sampling coverage error and increase the generalisability because this error is relevant to the completeness or otherwise of the list from which the sample was drawn (Dillman 2011). The random sampling approach was used to choose the sample from the population of Australian logistics companies to associate an equal and known chance of being selected to each member of the population, decrease the bias and increase generalisability.

It is crucial for survey respondents to reflect the characteristics of the target population because the usefulness and accuracy of the results rely on the coverage of its sampling frame. A biased sample that is systematically different in demographic characteristics compared with the intended population may produce inaccurate results. Therefore, selecting a sampling frame that maximises coverage within the target population is key to collecting accurate information (Guo et al. 2016). Thus, attempts to mitigate the possibility of non-responds in this study is managed by sending the motivating invitation email, including information about the benefits of this study.

Unit non-response and item non-response are two forms of response bias occurring in surveys (Dillman 2011; Groves et al. 2011). Either participant refusal or non-contact in a probability sample should manage to provide unbiased inferences (Groves &

Couper 2012; Singer 2006). Replacing participants randomly from the population is a useful approach by which to reduce unit non-response error, as suggested by Pateman (2015) to maintain the number of the sample. Similarly, in the pre-testing process, the confidentiality assurances, the logical construction of the survey and guide to thinking and engagement of the respondent are useful in potentially minimising the item nonresponse (LaRose & Tsai 2014).

Another error is measurement error that is relevant to the researchers, the respondents, the mode of data collection and the questions (Singleton & Straits 2002). Inaccurate or vague answers or some answers that are not comparable with other respondents' answers for some reason cause this error (Dillman 2011). Poor design of the questionnaire and the questions' wording can lead to this error and can be solved in the pre-testing process (Pateman 2015). To prevent this error, a pre-test of the questionnaire was done in this study which was discussed in the previous sections of this chapter. It is important to develop survey questions that do not have any effect on the respondents' answers and subsequently the survey's outcome because a biased survey generally is attributed to errors caused by the survey and its questions' design. For instance, a leading question can induce the respondent to answer in a specific manner. Some questions put experts on the defensive about their experience and situation and loaded questions may force the respondent to answer in a particular way, such as in the affirmative or negative (Leggett 2017). Therefore, the pre-testing process is used to exclude leading and loaded questions from the questionnaire and prevent the data from skewing.

According to Homburg (2012), both systematic measurement and random measurement errors are two types of measurement errors, which occur by utilising key informants. Although recognising bias or systematic measurement error is difficult, adopting strict pre-testing procedures, double-checking the data entry procedures and triangulation with web-based data can minimise this error (Harzing, Reiche & Pudelko 2013). Therefore, in this study, questions were made as clear as possible and the pre-testing of them was conducted because the pre-test reduces random measurement errors (McCarthy et al. 2017).

4.7.1 Bias management

When researchers use small samples, they risk losing statistical power in their results (De Beuckelaer & Wagner 2012) and even low rates of non-response can significantly affect the results of a survey (Clottey & Grawe 2014). Thus, the possibility of non-response bias can be tested and the reasons for choosing a small sample can be reflected (Clottey & Grawe 2014). When the results of respondents who answer a survey are different from sampled individuals who did not respond, non-response bias is defined (Dillman 2011). Statistics such as regression and path coefficient cannot depict the population investigated validly when respondents are different from non-respondents which can cause inaccurate, unreliable and misleading results (Wagner & Kemmerling 2010). In addition, some respondents select and answer only certain questions based on their sensitivity to a question and some of them may not complete the questionnaire (Leggett 2017). The root cause of respondents' behaviour is not fully understood by researchers because they cannot ask about the reasons (Leggett 2017).

Sample frame and non-response bias are the most commonly cited issues of web-based surveys (Fleming & Bowden 2009). Non-random exclusion of individuals from the sample frame is another issue. Sample biases to any web-based research remain in most populations due to an enduring social and spatial divide in access and use of the Internet (Callegaro, Manfreda & Vehovar 2015; Leggett 2017). When respondents within the sample frame have several demographic characteristics or attitudes to compare with those who do not respond, non-response bias is the bias introduced. Several levels of technical ability, which are present among potential respondents, can increase this bias and it becomes a problem when response rates are low (Fleming & Bowden 2009; Heeringa, West & Berglund 2017). Thus, this study chose random sampling for collecting data and uses the t-test for identifying any non-response bias possibility in this study which will be done and explain in Chapter 5. Since the target population of this research is finite, the table developed by Krejcie and Morgan (1970) was used to determine the sample size. For random sampling, firstly, a table of the population was generated and numbered including all logistics companies, according to the provided list from the database. Then, a starting point on the random number table was selected as well as using a direction of five added numbers to complete the acceptable number of required sample member. The invitation email and reminders including the link of web-based survey and participant information sheet were sent to the sampled members.

4.7.2 Validity

Accuracy, trustworthy and credibility of research are demonstrated by validity (Chu et al. 2016). Although validity and reliability are two technical considerations relating to the construction and evaluation of measurement (Babbie 2013), achieving perfect reliability and validity in social science research is challenging because of the ambiguous nature of social constructions (Pateman 2015). The pre-testing process of the research study and the literature reviews, which includes other authors' conceptualisations of the constructs, determines both face validity and content validity (Babbie 2013). The degree to which the content of the test matches a content domain associated with the construct is validated by content validity evidence while the face validity is an estimate of whether a test appears to measure a certain criterion (Chu et al. 2016). Therefore, to increase validity, the survey instrument was prepared based on the outcomes of discussion and the literature review. In addition, to enhance the content validity of the survey instrument, academics and professionals were asked to comment on the questionnaire in terms of wording and scale of the items. Drawing the sampling frame for data collection improved the internal consistency of the study.

4.7.3 Reliability

Although reliability is based on the possibility of replicating results cannot ensure accuracy (Babbie 2013), the reliability can be increased by asking experts questions about their area of expertise (for example, senior logistics managers in this study) and can lead to the reduced probability of inappropriate decision making in management (Pateman 2015). In the pre-testing process, training and activity will reduce measurement unreliability (Babbie 2013). Besides the pre-testing process in this study, Cronbach's alpha (α) is used to assess the reliability of the study. Cronbach's alpha coefficient is used to determine the reliability of the questionnaires. This method is used to calculate the internal coordination of a measurement tool such as the questionnaire and is discussed in the following chapter.

4.8 Summary

This research investigates the developed conceptual framework from Chapter Three empirically through a deductive approach and quantitative method. The strategy of the quantitative method associated with this study is a cross-sectional survey using a highly structured instrument with close-ended questions and some open-ended questions. This study quantifies the issues by transforming data into usable statistics for collecting data with close-ended questions. The data will be collected from a large sample, drawn from Australian logistics companies because they offer an extended range of services such as transportation, warehousing, storage, packaging and labelling within supply chains that can be improved to be environmentally-friendly. In addition, logistics services have an intangible nature and limited studies have been conducted that are related to environmental focused services. Moreover, Australia is a large country and has many ports. Thus, logistics companies and services make a substantial contribution to its economy. Consequently, the logistics industry is of high importance. The unit of analysis is the individual, senior manager, for instance, chief executive officer, managing director or logistics manager. The purest form of probability sampling is random sampling strategy, which was used in this study because generalisation is gained through statistical probability, and sampling with convenience and random selection. The web-based survey was chosen because of its advantages such as reduced cost, convenience, geographic access and improved timeliness. The Survey Monkey website was used for developing the web-based questionnaire. The pre-testing process and administration of the web-based survey including invitation email, ethics approval and sending reminders were discussed to highlight. The relevant error control processes have been applied to ensure reliability and validity of the research instrument and processes. The contributions of this chapter are as follow:

- Presenting a figure to show the research study's process from the literature review to collecting data including steps and relevant chapter number to clarify how the research process is conducted.

- Providing information on the most appropriate day and time to collect data from the sample of this study according to the rate of receiving responses among different weekdays and time.

- Providing a table to show the summary of the questionnaire in terms of question number and type (qualitative, quantitative, open or close-ended) with their literature focus, particular scale and indicating the relevant section of the conceptual framework covered by questions.

- Developing and suggesting the use of pairwise comparing questions instead of using a pairwise comparison matrix in AHP to reduce the complexity of the questionnaire that may increase the response rate.

- Providing required documents such as ethics approval, pre-test, invitation email and two reminders to collect data as well as justifying them.

- Checking both face and construct validity of the questionnaire by using the literature and conducting pre-testing.

The Fifth Chapter provides the descriptive statistics, data analysis and discussion on influencing factors towards environmental adoption (left side of the conceptual framework) and the Sixth Chapter provides data analysis and discussion on the relationship between implementing environmental activities and improving sustainable performance (middle and right sides of the conceptual framework shown in Chapter Three.

CHAPTER FIVE: DATA ANALYSIS AND DISCUSSION: FACTORS INFLUENCING ENVIRONMENTAL ADOPTION

5.1 Introduction

There are two data analysis and discussion chapters. This chapter focuses on factors influencing environmental adoption as well as the most undertaken environmental activities in Australian logistics companies in the last five years and the next chapter focuses on the effects of implementing environmental activities on improving sustainable performance. This chapter reports the results of the web-based survey to answer the SRQ1 and SRQ2 of this study and to provide an examination of the demographic information for the 61 web-based survey respondents. The objectives of this chapter are identifying the most important factors influencing environmental activity adoption as well as clustering these factors (section 5.5). Identifying the most implemented environmental activities by Australian logistics companies in the last five years is another objective of this chapter (section 5.6).

This chapter consists of five sections. Following an outline of the survey response rate (section 5.2), section 5.3 presents the demographic background of survey respondents. Section 5.4 explains the reliability and descriptive statistics of the variables, and section 5.5 explains the results of the Exploratory Factor Analysis (EFA) and Friedman test to cluster and rank the factors influencing environmental activity adoption in Australian logistics companies to answer SRQ1. Section 5.6 represents the analysis of collected data to investigate the most implemented environmental activities in Australian logistics in the last five years to answers the SRQ2. Table 5.1 summarises the analysis and discussion in this chapter. Some variables in the fourth column of Table 5.1 are referred to the conceptual framework of the current study shown in Figure 3.2. The left side of the conceptual framework includes factors influencing environmental adoption, the middle side of conceptual framework referred to environmental activities and the right side of it consists of sustainable performance measures. The feedback vector of Figure 3.2 (from the right side of the conceptual framework to the left side of it) shows the possible relationship between improving sustainable performance and its effect on increasing environmental adoption.

Table 5. 1 Road map of Chapter 5

Section in this chapter	Survey questions	Research question	Variables (section of the conceptual framework in Figure 3.2)	Statistics test	Reason
5.3	1–6	-	Demographic	Descriptive analysis	Describing the basic features of the data
5.4	7–46	-	All variables and sections	Cronbach's alpha	Testing the reliability
5.5.1	31, 32	SRQ1	Factors influencing environmental activity adoption (left side and the feedback vector)	EFA	Clustering and ranking the factors
5.5.1	31	SRQ1	Factors influencing environmental activity adoption (left side and the feedback vector)	Friedman test	Ranking the factors
5.5.2	33	SRQ1	Factors influencing environmental activity adoption (left side and the feedback vector)	Categorical	Identifying new influencing factors toward environmental activity adoption
5.6	34	SRQ2	Environmental activities in logistics (middle side of the conceptual framework)	Descriptive and categorical	Identifying new implemented environmental activities and the level of environmental activity adoption

5.2 Response rate

The questionnaire was distributed to 297 managers of Australian logistics companies holding different positions including chief executive officer (CEO), managing director, logistics manager, operational manager and general manager. After the invitation email, some attempts were made to increase the response rate such as sending two reminders in the first and second week respectively. After receiving the first responses and according to the time of survey completion as well as start time and finish time, it was inferred that managers (respondents of the current study) preferred to answer the survey early in the morning and at lunchtime in that period of time. This information was available from the Survey Monkey website which shows the time length of responding as well as start time and finish time. In addition, understanding the pattern of the most suitable days of the week for respondents to engage in the survey assisted in finding the most appropriate days in which to garner more responses. The collected data indicated that Mondays and Fridays were not as appropriate for completing the survey and the response rate was higher on other workdays. In addition, some respondents preferred to answer on weekends. Consequently, subsequent invitation emails and the two reminders were sent early in the morning and at lunchtime on Tuesdays, Wednesdays and Thursdays. This pattern provided a potentially increased chance of receiving responses.

A total of 88 responses were received, of which 61 were fully completed. Therefore, in total, a 21% response rate was achieved, giving a reasonable credence to the web-based survey when compared to other web-based surveys of research of a similar nature (green supply chain management and logistics) such as Chavez et al., (2016) with a 21.5% achieved response rate and Szegedi, Gabriel and Papp (2017) with a

21.5 % achieved response rate. The response quality for data obtained is considered high when the average number of questions respondents leave unanswered is small (Jordan et al. 2014; Sue, Ritter & Lois 2007). In this study, more than 60% of the incomplete responses showed fewer than three out of 46 unanswered questions. Thus, the quality of the obtained data is acceptable.

The current research used 'don't know' as an option to prevent the respondents from forcing to choose other options randomly when they answer the questions. It can increase the reliability of responses, though decreasing the number of completed responses with missing data (Denman et al. 2018). In terms of missing data, there are two suggested solutions including eliminating the questionnaire and imputing the missing data (Van Buuren 2018). Some scholars such as Curran (2016) and Hulland, Baumgartner and Smith (2018) suggest eliminating questionnaire with more than 10% missing data. The mean substitution is used to impute the missing data when the missing data is less than 10% (Lang & Little 2018; Netten et al. 2017). Eliminating incomplete questionnaire and mean substitution were used to deal with missing data in the current study. The results showed that 61 out of 88 received responses were completed, although all respondents answered demographic questions. There were 11 respondents (17%) of the sample that withdrew from the survey after demographic questions (question 1-6). It showed that they were not familiar with the context of environmental activities and sustainable performance. The results showed that 24 of respondents (27%) left question 32 empty but they continued on with the survey. Question 32 was about ranking factors influencing environmental adoption. It showed that they may not have sufficient insight into the context of influencing factors toward environmental adoption. Only five respondents withdrew from the survey after question 32. Overall, the last section of the questionnaire was answered by 64 of respondents (72%) which indicated that only 24 respondents withdrew from the survey in total. Analytical hierarchy process method suggests the use of asymmetrical matrix or a table consists of the same numbers and criteria name in both rows and columns to have a pairwise comparison in each cross home of table. Although pairwise comparison is easy to answer for experts who are familiar with AHP, the use of 4 comparison matrix makes the questionnaire complex for respondents. The complex and unfamiliar questionnaire design may increase the risk of withdrawing and low response rate. Thus, the last section of the questionnaire was designed in question format for pairwise comparison instead of using comparison matrix. To make pairwise comparison easy for respondents, twelve questions were designed and each question compared the importance of two criteria with each other instead of each cross home of pairwise comparison matrix. Receiving 72% of completed responses in this section showed the success of this design. This study removed the questionnaires with incomplete data and further analysis was done for 61 complete responses as the approach to deal with more than 10% missing data explained in the previous page.

A non-response bias may contaminate the reliability of the study's results when the survey response rate is less than 100% (Armstrong & Overton 1977; Shang & Lu 2012). Therefore, there is a need to conduct a test of non-response bias. In the current study, the 61 completed responses were divided into two groups, early (n=30, 49.2%) and late (n=31, 50.8%) respondent for assessing the non-response bias. The results showed that there were no significant differences between the two groups. Therefore, this suggested there is no evidence of non-response bias for this study.

5.3 Demographic results of the survey respondents

The collected demographic information from the survey enabled this study to understand the respondents' characteristics for examining any potential differences across Australian logistics companies. The demographic data includes the manager's position, years of experience as a manager, types of logistics services offered by the company, the number of employees, annual revenue of the company and the type of environmentally-friendly energy sources used by a company. The data collected from the demographic questions can be useful in analysing the results from various perspectives. For example, a one-way analysis of variance (ANOVA) test will be used to identify the effects of the manager's position on sustainable performance measures in the next analysis chapter (section 6.2). The following sections detail the demographic results.

5.3.1 Respondents' positions

Figure 5.1 presents information about the frequency and percentage of respondents from several positions including chief executive officer, managing director and general manager. It indicates that the highest percentage of the respondents were general managers, which accounts for 23% (14 respondents), followed by the frequency of managing directors (13 respondents) and logistics managers (12 respondents). The number of respondents from these three positions are almost equal and 64% of responses belong to these groups. However, the lowest percentage (5%) in relation to the participant's position is that of chief executive officer which accounts for three responses. This lowest percentage of responses and its relevance to the highest positions of managers may be due to some respondents' limited time. 'Other respondents' (15%) were two warehouse and distribution centre managers, two accounts and sales managers and three business development managers. There was also one national customs manager as well as two consultancy managers comprising other positions of respondents. Figure 5.1 shows the various percentages of the positions of respondents.

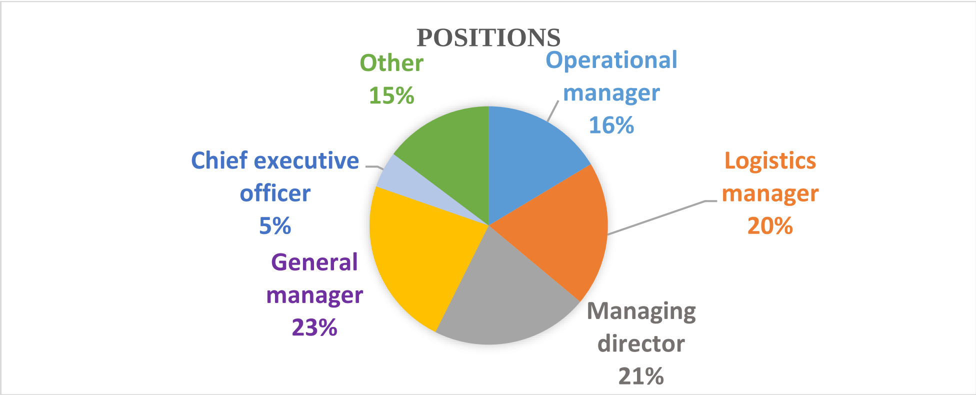

Figure 5. 1 Percentage of respondents' positions

Managers from various positions may have different opinions about the effects of implementing each environmental activity on improving each measure of sustainable performance. Therefore, an ANOVA test (Appendix J) was used which will be explained in Chapter Six in each section related to each environmental activity to investigate the effect of manager's position on the variance of each measure of sustainable performance related to that environmental activity.

5.3.2 Respondents' years of experience

To make a better comparison among the sample, the years of experience that respondents had gained in their current positions are divided into four groups. The results show that 29% of the respondents (18 managers) in logistics companies had 6–10 years of management experience in their current companies, which is the largest group of respondents. Conversely, the smallest group of respondents consists of 12 managers (20% of respondents) with more than 20 years of experience in their current positions. The percentage of respondents with 11–20 years of experience is 26% (16 respondents) which is approximately equal to the number of the group with five or fewer years of experience (15 respondents or 25%). Although the numbers of respondents are roughly divided into four groups, 75% of respondents had more than 6 years of experience and approximately 50% of them had more than 10 years of experience in their current positions, which shows that the respondents should have a good insight in terms of their companies to answer the questions with valid answers. Figure 5.2 shows the results of this demographic question.

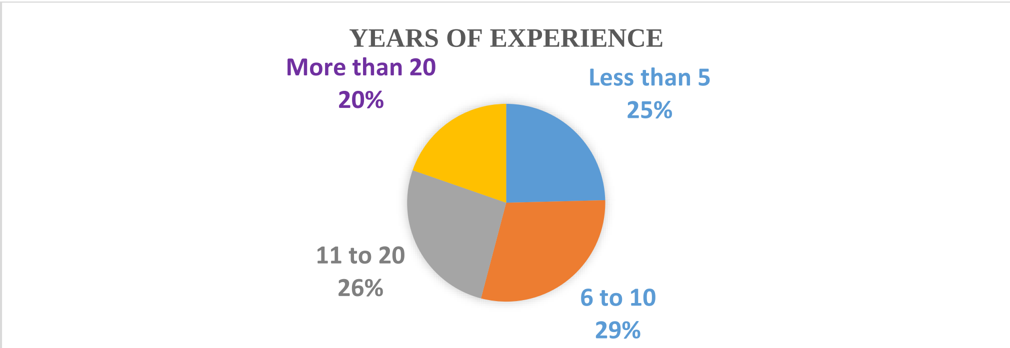

Figure 5. 2 Percentage of respondents' years of experience

The results show that 25% of respondents had five or fewer years of experience in their current positions. Analysis of this group reveals that 30% of them were logistics managers, 30% were operational managers, 10% general managers and 30% had other positions such as business development manager and accounts manager in their current companies. Thus, 75% of respondents with five or fewer years of experience were not from managing director and chief executive officer positions which have the highest level of management in the sampled companies and 90% of general managers of the sample have more than five years of experience in their current positions.

Therefore, managers with higher positions and more than six years of experience may provide the survey with credible responses.

5.3.3 Types of logistics services offered by companies

Respondents were asked to indicate the logistics services offered by their companies to reveal the level of business capability in the Australian logistics industry because there are several logistics actors in this industry. For example, first-party providers (1PLs) carry out only freight forwarding services while fifth-party providers (5PLs) offer a wide range of logistics services including freight forwarding, warehousing, supply chain and network consultancy (Lam & Dai 2015; Coyle et al. 2016; Higgins and Ferguson 2011). In addition, the results of this demographic question will be used in the next analysis chapter to compare with the implemented environmental activities in the last five years. This comparing can show which actor implement which environmental activities (section 6.4 in the next analysis chapter). The percentage of several types of logistics services offered by the sampled logistics companies are shown in Figure 5.3.

Figure 5. 3 Percentage of offered logistics services

As shown in the pyramid of logistics industry discussed in Chapter 2 (Figure 2.1), there are several actors defined based on the domain of their services offering (Higgins and Ferguson 2011). This research question is designed to determine the percentage of each actor in the sample of the current study based on the logistics pyramid. The results of this demographic question show that there are three main logistics services offered by Australian logistics companies in the sample, these being freight forwarding, warehousing and distribution, which belong to first-party (1PL) to third-party (3PL) logistics. The collected data revealed that 78% (48 companies) in the sample offer freight forwarding and 75% of sampled companies offer warehousing and distribution as well as freight forwarding. Therefore, only three percent of the logistics companies in the sample carry out freight forwarding and distribution without the use of their own warehouse and storage. Therefore, this group (three percent of the sample) comes within the category of first-party logistics (1PL) which only offers transport services and 75% of the sample belonged to 3PLs.

Consultancy and project services is an activity which is offered by fourth- and fifth-party logistics companies (4PLs and 5PLs) which have a higher level of logistics business than third parties because they offer consultancy services to other companies or within supply chains and networks as well as regular logistics activities which are offered by 3PLs. Lead logistics providers (LLPs), namely 4PLs and 5PLs, carry out services at advanced levels such as consultancy and project services. They carry out logistics services and develop business in cyberspace (Lam & Dai 2015). Consultancy and project services account for 44% (27 companies) in the sample of the current study which means that 44% of the sample are 4PLs and 5PLs offering all types of logistics services. However, only 13% (eight companies) of the sample solely offer consultancy and project services without carrying out any other logistics services. Since consultancy and project services are not physical activities, they do not have a substantial effect on the environment. To summarise, 3% of the sample are 1PLs, 75% of the sample are 3PLs, 13% of the sample are 4PLs and 5PLs that offer only consultancy and project services and 9% of the sample carry out all types of logistics services. Therefore, near 90% of the sample offer physical logistics services which have negative effects on the environment. Thus, investigating the effects of environmental activity adoption on the environment and logistics business could be an important context in the Australian logistics industry which is the objective of this study.

The various logistics actors are defined based on the logistics services offered by them which is a way to distinguish the level of logistics actor. Actor type in a logistics company which is described by the number of services offered by that company according to a multi-layered service framework (Urciuoli 2010). In addition, different logistics actors may be affected by different influencing factors toward environmental adoption. Therefore, the effects of the logistics services offered by a company on the means of influencing factors toward environmental adoption in Australian logistics companies need to be investigated and will be discussed in section 5.5.3. It will show which influencing factors have the most effect on what logistic actor toward environmental adoption which can be used for making policies to increase environmental adoption in Australian logistics.

Packaging and labelling occupy the forth rank among six logistics services with regard to regular services offered by logistics companies in this study. These logistics services offered by 31% (19 companies) in the sample of current study which may belong to 3PLs to 5PLs. The results show that packaging activities are not offered by many logistics companies in the sample, although according to Rundh (2016), Čekanavičius, Bazytė and Dičmonaitė (2014) and Lorentz et al. (2011), this activity has the potential to reduce waste and protect the environment. Therefore, implementing the environmental activities related to three main logistics activities with the highest percentage in the sample (freight forwarding, warehousing and distribution) having the most potential and importance to decrease the negative impact on the environment.

5.3.3.1 Other logistics services offered by the sample

Since this demographic question was designed as open-ended, respondents were asked to indicate any other logistics services offered by their companies. Responses from 11% of respondents (seven companies) indicated that their company offers other logistics services such as oversize transport (heavy haulage transhipment), international trade and organising weekly schedule ship date as well as compliance and enforcement services. Customs clearance and customs brokerage formalities, construction projects, hiring a crane, wharf operations and projects for mining and oil/gas are other types of logistics activities offered. Respondents also indicated forwarding dangerous goods with controlled temperature, emission reduction activities and fuel savings as other services which are environmentally-friendly. Some Australian logistics companies also offer international trade, compliance, and enforcement/regulation services.

5.3.4 Number of employees (by headcount)

Since the number of employees can be considered as an index to identify the size of the company (Swanepoel & Harrison 2015), the respondents were asked to answer this demographic question and the distribution of respondents in the sample can show the credibility of the sample size. Figure 5.4 shows the frequency and percentage of logistics companies by different sizes.

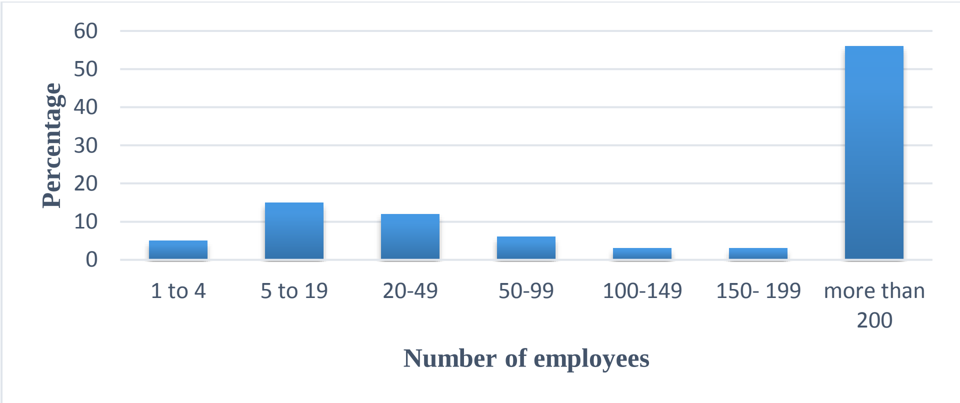

Figure 5. 4 Percentage of logistics companies based on the number of employees

The survey data revealed that the majority of respondents, 56% (34 managers), were working in large companies with more than 200 employees and the percentage of the respondent from medium companies in the sample is 12%. Thus, 68% of the sample were managers from large and medium companies with more than 50 employees. Results showed that 32% (19 managers) belonged to small businesses because they have fewer than 50 employees (Swanepoel & Harrison 2015) and less than 5% of the managers in the sample of this study were working in micro businesses because they have four or fewer employees and a total business revenue of less than $2 million (Australian Taxation Office 2015). Therefore, most respondents may have sufficient insight about social performance which was an important part of the questionnaire of this study and it shows the credibility of sample size.

Subgroup analysis of the collected data showed that in the small business group, the number of respondent companies with 5–19 employees (16%) is more than the number of companies with 20–49 (11%). In addition, considering the frequency of three subgroups of medium size companies (50-99, 100-149 and 150-199) showed that the majority of medium-sized companies (50%) in the sample have 50–99 employees.

5.3.5 Annual revenue

To increase the credibility of sample size, the distribution of respondent is analysed based on companies' annual revenue because annual revenue is one of the factors that as well as the number of employees indicates the size of a company (Swanepoel & Harrison 2015). Figure 5.5 illustrates these clusters.

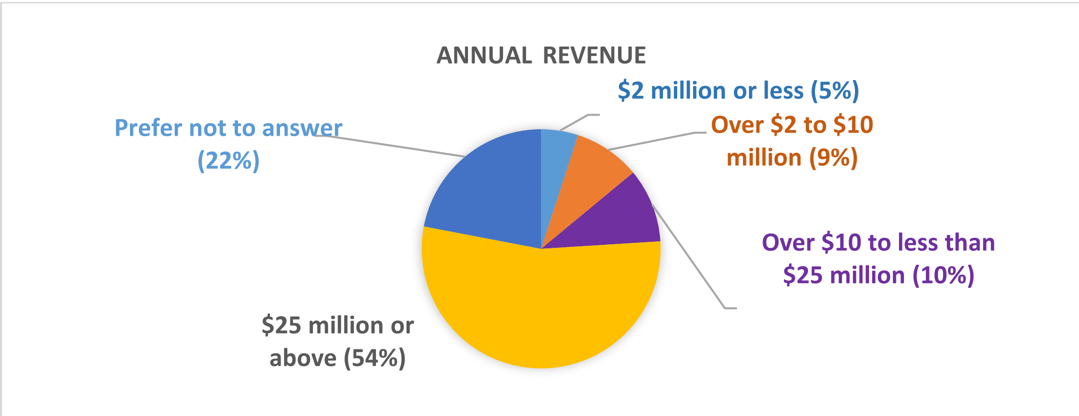

Figure 5. 5 Percentage of companies' annual revenue

According to the collected data, 54% of the respondents worked in large companies because they have annual revenue of $25 million or above (Australian Taxation Office 2015; Australian Bureau of Statistics 2014). In addition, 24% of respondents were employed by companies with annual revenue between $10 to $25 million. Overall, the results showed that a majority of the respondents (64%) were managers from companies with more than $10 million annual revenue. In the sample of the current study, 5% of respondents worked in the micro business with less than $2 million, 9% worked in small businesses with up to $10 million in revenue per annum and 10% are medium businesses with over $10 to less than $25 million in revenue.

The percentage of large, medium, small and micro companies in the sample was also identified by the previous demographic question, which asked respondents about the number of employees. Comparing the results of two demographic questions (about the number of employees and annual revenue) showed that the percentage of large companies were approximately equal (56% and 54%). This comparing also showed that the percentage of medium companies were also approximately equal (12% and 10%) and the percentage of micro companies were 5% in both questions.

The percentage of small companies in the sample is 32% according to the demographic question asking the number of employees. However, the demographic question asking the annual revenue showed this percentage like 9%. The differences of the percentages (22%) showed that many of small business in the sample chose ‘prefer not to answer’ which was designed for those respondents who were not willing to answer the question because a question concerning annual revenue can be a sensitive question in a survey and some respondents may not be willing to disclose their annual revenue even though responses are kept anonymous (Findley et al. 2017). This option was designed to prevent them from withdrawing from the survey and nearly a quarter of them (22%) chose ‘prefer not to answer’. Although all 22% of ‘prefer not to answer’ may not be relevant to small companies, many small businesses chose this option to answer the question which may have roots in the tax or other policies from the government.

5.3.6 Environmentally-friendly energy sources

This question was designed to identify the level of using environmentally-friendly energy sources in Australian logistics companies. The survey data revealed that 56% of respondent companies do not use any environmentally-friendly energy sources and tidal power is the environmentally-friendly energy source that is not used by any of the respondent companies. Solar power is the most used environmentally-friendly energy source which is used in 46% of the respondent companies. Around 9% of respondents indicated that their company uses other types of sources such as a powershop (carbon neutral), although they also indicated that they were not sure of the mix of Xenon fuel and lubricant additives. Powershop has decided to become Australia’s first 100% carbon neutral energy retailer. Powershop is an Australian and New Zealand-owned retailer with a unique approach to energy. Unlike traditional providers, Powershop lets consumers pre-purchase electricity with its 'powerpacks'. Wind power after tidal power is the second least used environmental energy source, accounting for 1%. The results reveal that only 2% of the sample, who have more than 200 employees with more than $25 million annual revenue, use electrical power, electric and lower emission vehicles. The results show that 42% of the sample use none of the indicated environmental energy sources and had not introduced any other environmentally-friendly energy source. The results also reveal that 46% of respondents use solar power while only 8% of respondents use wind power and other environmental sources. This shows that solar power is the most common environmental energy source in the sample because more than 85% of the companies that have used environmental energy sources opted for the use of solar power. This form of renewable energy is a growing industry in Australia, as shown by statistics from the Australian Energy Council for installation solar system capacity and average system size during the period January 2012–2017 (Chapman, McLellan & Tezuka 2016; Fuller, Rajagopalan & Duverge 2017; Sahu 2015). Figure 5.6 shows the frequency and percentage of environmental energy sources.

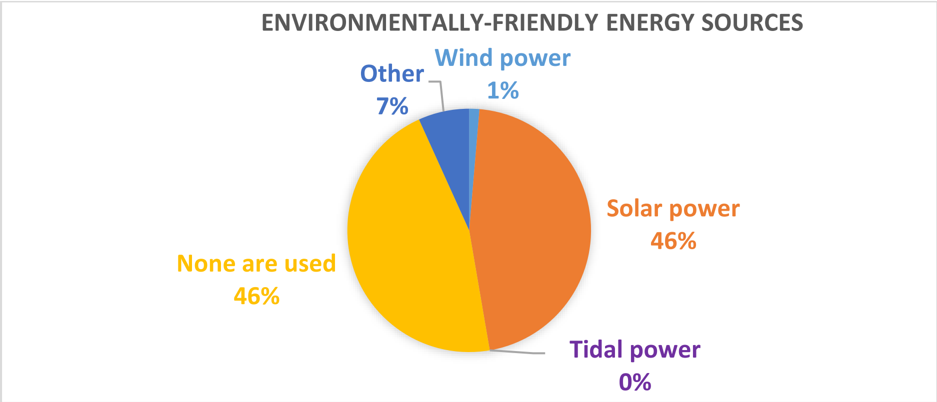

Figure 5. 6 Percentage of use of environmentally-friendly energy sources

This study used demographic analysis to investigate the credibility of its sample. Both response rate and quality play a vital role in ensuring that the collected data are representative of the intended sample (Muñoz-Leiva et al. 2010). Overall, the results show that only 11 respondents withdrew from the survey after the demographic questions in the first section of the questionnaire. It means that others were familiar with the context of environmental adoption and sustainable performance. The results show that these 11 respondents consist of six logistics managers, three general managers and two operational managers. The managers of large and medium business have sufficient insight into economic performance. Since 54% of the sample companies have annual revenue of $25 million or above, and 64% of the sample companies have more than $10 million annual revenue, they could provide valid and valuable responses about the effects of implementing environmental activities on economic performance. In addition, around 60% of the sample were managers of companies with more than 200 employees that have knowledge and experience about human resources and social performance. These managers represent 50% of the respondents who had more than 10 years' experience in their current positions. Moreover, around 75% of managers belonged to 3PLs offering various types of logistics services and around 13% of respondents were employed by lead logistics companies (4PLs and 5PLs) offering consultancy and project management services within supply chains and networks. Therefore, the managers had sufficient experience and work knowledge into their companies and were able to provide responses to the current study.

5.4 Reliability and descriptive statistics of variables

This section represents the descriptive statistics of responses to several sections of the questionnaire of this study. Cronbach's alpha (α) reliability analysis was conducted because it assesses the internal consistency of each section of constructs/scales (Field 2009; Pallant 2011). Table 5.2 shows Cronbach's alpha for eight environmental activities (the questions included in section two, three and four of the questionnaire with the use of a five-point Likert scale). In addition, Table 5.2 shows the Cronbach's alpha coefficient, which was calculated by using SPSS software for 12 influencing factors (common between question 31 and question 32) as well as 12 questions for pairwise comparison.

Table 5. 2 Cronbach's alpha coefficient

Variable	Number of investigated measures	Cronbach's alpha
Use of environmentally-friendly energy sources	9	0.874
Replacing old vehicles	9	0.890
Optimisation of the distribution process	9	0.848
Use of environmental management system	9	0.953
Efficient storage of goods	9	0.927
Use of energy-efficient refrigerant	9	0.951
Waste control	9	0.877
Recycling packaging material	9	0.889
Influencing factors	12	0.891
Pairwise comparison questions	12	0.754

Question 31 (in section five of the questionnaire) asked the respondent to score these influencing factors toward environmental adoption and Question 32 asked them to rank these factors (from 1 to 12 where 12 was the most influential) in the same section of the questionnaire. The last section of the questionnaire focused on the pairwise comparison of three dimensions of sustainable performance as well as its nine measures.

Internal reliability was considered acceptable for each of the constructs/scales at 0.7 above (Field 2009; Pallant 2011). The Cronbach's alpha values for all constructs/scales of this study were found to be well above 0.7 (Table 5.2), which ensured the scale's internal consistency except Question 32. Question 32 was designed clearly, and the pre-test was done for examining the accuracy of this question to rank the influencing factors. Despite the use of clear wording in this question and explaining that 12 is considered as the most influential, some respondents had chosen 1 as the most influential factor. The responses to this question showed that some respondents misinterpreted this question. The misinterpreting caused inconsistency of data and, consequently, zero value for the variance for Question 32. Therefore, according to Table 5.3, the variance of Question 32 is 0.000 and zero value for the variance shows that the standard deviation is not normal. Thus, the Cronbach's alpha is not calculable for this question which was not shown for this question in Table 5.2.

Table 5. 3 Scale statistics of Question 32

Mean	Variance	Std Deviation	N of Items
78.000	0.000	0.000	12

The collected data from Question 32 are not useful for analysis and ranking. However, since the considered factors in this question were common to both Questions 31 and 32 and the managers had been asked to score these factors in question 31, the collected data from question 31 could be used to rank these factors. Hence, Question 32 with an unacceptable Cronbach's alpha coefficient was therefore ignored and the Friedman test was used to rank these factors based on collected data from Question 31. The Friedman test and its results are explained in section 5.5.2 of this chapter, after the EFA.

Some scholars such as Frikha and Moalla (2015) believe that calculating the inconsistency rate for pairwise comparison matrix in the analytic hierarchy process (AHP) method is sufficient for accepting the reliability of these questions. However, others such as Wang et al. (2014) calculate Cronbach's alpha test for indicating the reliability of data and claim that the inconsistency rate of AHP shows to what extent respondents were accurate for pairwise comparison. In this study, the reliability test, which reflects the consistency of measurement, was conducted for these questions to show that if the sample is changed, to what extent the same results will be achieved (Bonett & Wright 2015) and the result shown in Table 5.2 with an acceptable amount

(0.754). In addition, the inconsistency rate of each matrix was also calculated for pairwise comparison and this is shown in Chapter 6 where the analysis and discussion are presented.

5.5 Ranking factors influencing environmental activity adoption

This section first reports the results of the EFA and then the results of the Friedman test to categorise and rank the factors influencing environmental activity adoption for Australian logistics companies. EFA is used to categorise influencing factors and identify the underlying latent relationships between them because it is an appropriate technique to define a hypothesis in terms of the number of underlying factors of data and their relationship (Fabrigar & Wegener 2011). EFA is an exploratory technique (not a confirmatory technique) which investigates the factor structure of a set of observed variables without imposing a predefined structure on the outcome (Osborne 2015) and, according to Reio and Shuck (2015), EFA is frequently used for reducing large sets of variables into more manageable components.

According to Baglin (2014), although both EFA and principal components analysis (PCA) are used to reduce the number of dimensions in the data, both make very different assumptions. EFA focuses on identifying the underlying latent factor structure with determining the relationships between the observed variables (Reio & Shuck 2015), while PCA reduces a large number of interrelated variables into a smaller set of 'components' with minimal loss of information. The common or shared variance between variables is the basic element of EFA, which is broken away from the leftover variance unique to each variable and any introduced measurement error (Baglin 2014). Hence, EFA has a more theoretical alignment to explore the dimensions of a scale and find a latent variable. EFA is the most appropriate technique for this study because there is not a previous hypothesised structure and the influencing factors in the conceptual framework were developed and tested for the first time. In addition, EFA is used when the researcher cannot assume the priority or the structure of the variables as well as the relationships between them and needs to rely on the sample to estimate these (Matsunaga 2010).

5.5.1 Factor analysis for influencing factors

This study collected some influencing factors towards environmental activity adoption from the literature and this chapter attempts to cluster those factors which have not been previously explored in the case of the Australian logistics industry. EFA is used to explore the main components among influencing factors and find a latent variable as well as cluster and rank the influencing factors. EFA is used to answer the SRQ1 of this study, which is as follows:

> ***SRQ1:*** *Which factors have a greater influence on logistics companies toward adopting environmental activities?*

The recommended sample size in factor analysis is five to ten for each variable (De Winter & Dodou 2010; De Winter, Dodou & Wieringa 2009). Kaiser-Mayer-Olkin (KMO) is the index of SPSS software for investigating and yielding a suitable sample size for EFA. The value of KMO must be more than 0.7 (Yong & Pearce 2013) to show that the number of data observations has been sufficient for EFA. The value of KMO and Bartlett's index for question 31 is 0.818 which is more than 0.7 (Appendix H). Thus, it shows that the number of data observations have been sufficient for EFA.

Since this study attempts to explore and reduce the dimensions of factors and find a latent variable without missing any information, EFA was used to categorise 12 factors influencing environmental adoption which still have more than 70% of the variance. EFA helped this study to categorise 12 influencing factors by setting the factors with the same variance in a specific component. Each component of EFA includes some influencing factors that have a latent relationship among them (Fabrigar & Wegener 2011). Table 5.4 includes the SPSS output and shows that there are three components with more than 70% of the total variance. Therefore, 12 influencing factors were found to be dependent on three latent components.

Table 5. 4 Components of EFA with more than 70% of the total variance

Component	Percentage of variance	Percentage of cumulative
1	47.450	47.450
2	13.484	60.934
3	9.689	70.623

According to Scree Plot in Figure 5.7, the eigenvalue for the first three components is more than one and it means that there are three main components that can be generated by the EFA because where the slope of the curve is clearly level off indicates the number of generated components (Osborne 2015).

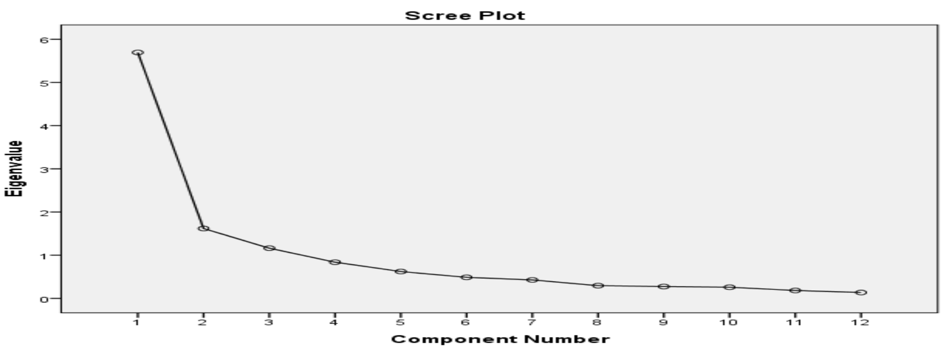

Figure 5. 7 Components and their eigenvalue from Question 31

EFA was ran two times and three components were finally extracted (Appendix H). In the first run of EFA, demand for environmentally-friendly logistics services showed the least coefficient which had very close amount among the three components of EFA (Appendix H). Demand for environmentally-friendly logistics eliminated because according to the literature, this factor stems from aware customers and social awareness and motivates companies to increase investment for greater environmental accomplishment objectives (Foster, Sampson & Dunn 2000). Aware customers expect to see environmental responsibility from a company and can be satisfied. Thus, higher social awareness can affect environmental adoption positively (Isaksson 2012; Seroka-Stolka 2014). The demand for environmentally-friendly services could be eliminated for the second run of EFA because remained influencing factors still include social awareness. Table 5.5 presents the results of the second run of EFA with the coefficient of each factor.

Table 5. 5 Components of EFA

	Components		
Factors influencing environmental adoption	**1**	**2**	**3**
Social awareness	.827	.090	.244
Company growing in size	.817	.254	.259
Potential for achieving a competitive advantage	.781	.219	.339
Increasing fuel and energy prices	.753	.024	.158
Employees’ interest in environmental activity adoption	.662	.187	-.180
Suppliers’ pressure	.012	.830	-.115
Competitor pressure	.324	.708	.346
Accumulation of new technologies	.179	.698	.335
Customer pressure	.287	.642	.460
Governmental regulations	.181	.114	.885
Governmental support	.151	.226	.831

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalisation.
a. Rotation converged in 5 iterations.

The value of KMO and Bartlett's index for question 31 in the second run of EFA is 0.784 which is more than 0.7 (Appendix H). It indicates that the number of data observations have been sufficient for EFA.

5.5.1.1 Social and economic factors

The first component of EFA, which has around 50% of the variance, includes five influencing factors which are the most influential. These five influencing factors belong to component 1 because their coefficient in component 1 is more than their coefficient in components 2 and 3. Component 1 includes social awareness, a company growing in size, the potential for achieving a competitive advantage, increase in fuel and energy prices; and employees' interest in environmental adoption.

Social awareness which includes demand for environmentally-friendly services is a strong external factor toward environmental adoption (Isaksson 2012; Lin et al. 2014) confirmed by the current study. A company's attempts to have environmental responsibility and offering environmentally-friendly services can satisfy aware customers (Salomone 2008). In addition, media can play an important role to introduce responsible or irresponsible companies to society (Issakson 2012). Consequently, a good image for a company affects brand popularity and provides new market opportunities. Therefore, social awareness is an external influencing factor motivating the sample for environmental adoption.

Some scholars (Hung Lau and Wang 2009; Walker, Di Sisto & McBain 2008) claim that smaller companies are under pressure from business partners within the supply chain due to having strong collaboration among them. The results of the current study confirmed it and showed that the size of the company is a factor influences environmental adoption. It means that even small companies are under pressure from their large business partner towards environmental adoption (Walker, Di Sisto & McBain 2008; Hung Lau and Wang 2009).

The results confirmed that the potential to achieve a competitive advantage is one of the strong factors that positively influence the sample for environmental adoption. Creating value for customers is a fundamental means of achieving a competitive advantage and a company can follow two generic routes to compete in a market to create super value for customers: differentiation or low cost which can create a competitive advantage (Slater & Narver 1998; Porter & Advantage 1985; Day 1990). Since carrying out environmental logistics services can create differentiation and customer value, environmental activity adoption has the potential for achieving a competitive advantage (Isaksson & Huge-Brodin 2013; Salomone 2008). Therefore, leading logistics companies can use environmental adoption as a means of achieving a competitive advantage.

Increasing in fuel and energy prices is indicated as an influencing factor for environmental activity adoption (Luthra, Garg and Haleem 2015; De Medeiros, Ribeiro & Cortimiglia 2014; Rezvani, Jansson & Bodin 2015). The results of the current study confirmed it as an influencing factor which acts as an external driver for implementing environmental activities.

The results of EFA confirmed that employees' interest also acts as an effective influencing factor in the sampled Australian logistics companies for environmental adoption. This factor is an internal factor which also drives Chinese logistics companies toward environmental adoption (Lin & Ho 2011**).** Other factors such as the quality of human resource, characteristics of human resource and the opinion of top manager are the same factors indicated by scholars (Seroka-Stolka 2014; Lin et al. 2014) and may belong to this group.

5.5.1.2 Pressure factors

Component 2 comprises pressure from suppliers, competitors and customers; and accumulation of new technology. The influencing factors of this component are discussed in order of their strength according to their coefficient in the second component of EFA.

The results of EFA confirmed that supplier pressure is a strong influencing factor toward environmental adoption as indicated by Isaksson (2012) and Tacken, Sanchez-Rodrigues and Mason (2014). Some scholars such as Salomone (2008) and Walker, Di Sisto and McBain (2008) claim that suppliers' pressure may not be an influencing factor for environmental adoption, which is not confirmed by the results of the current study for sampled Australian logistics companies because coefficient of this factor is high which shows the strength of this factor in the pressure group.

The results of EFA in this study confirmed that the competitors' pressure in the competitive market for capturing new market opportunities is a significant influencing factor for companies to implement environmental activities suggested by scholars (Salomone 2008; Dubey, Tacken, Sanchez-Rodrigues & Mason 2014; Gunasekaran & Ali 2015). Existing rivals adopting environmental policies and having the aim of being an environmental leader in the market drive logistics service providers to integrate environmental aspects into their activities to increase market share (Isaksson 2012).

According to scholars such as Gunasekaran and Ali (2015) and Foster, Sampson and Dunn (2000), this factor is an external factor.

The results of this study set the accumulation of technology in the component including three external factors which put pressure on the sample toward environmental adoption. Therefore, emerging new technology can be another pressure from the external environment affecting the sample for environmental adoption which is confirmed by EFA in the current study. Although Chien and Shih (2007) believe that accumulation of new technologies is an internal influencing factor putting pressure on companies for environmental adoption, Coyle et al (2016) claim that new technology is one of the external factors that affect the business environment.

The results of the EFA showed customers' pressure is an external factor influencing the sample of this study for environmental activity adoption. Scholars such as Gunasekaran and Ali (2015), Isaksson (2012) and Foster, Sampson and Dunn (2000) believe that customer pressure is an external influencing factor driving a company for environmental adoption. Customers' pressure prominently is indicated by scholars (Tacken, Sanchez-Rodrigues & Mason 2014; Seman et al. 2012; Trivedi 2016) because mature markets put pressure on companies to satisfy their customers with more customised and comprehensive value offerings (Roy et al. 2009). Changing customers' needs increases competitiveness and influences competitive advantage (Sigalas & Pekka Economou 2013). Creating value for the customer is the essence of competitive advantage (Porter 1985) and achieving a competitive advantage is one of the ways of surviving in the competitive business environment.

5.5.1.3 Governmental factors

Based on EFA results, governmental regulation and support belong to the third component. Comparing the coefficient of governmental regulation and support with the other factors in Table 5.5, these two factors were confirmed to be the most influential factors toward environmental activity adoption in the sample of this study. The result of current study is consistent with that of Lin and Ho (2011), indicating the regulatory pressure is an external factor which influences companies to adopt environmental activities in Chinese logistics. The results are also desinged with the findings of Lorentz et al. (2011) that states one of the most effective external factors is government which provides both pressures (Isaksson 2012; Walker, Di Sisto & McBain 2008; Wong, Turner & Stoneman 1996) and support (Lin & Ho 2011). The results is also consisted with that of Tacken, Sanchez-Rodrigues and Mason (2014), indicating legislation is an influencing factor towards environmental adoption.

EFA is an appropriate method to cluster the influencing factors while the Friedman test is chosen to rank these factors based on their importance for sampled companies. Although Question 32 was designed to have a ranking of this factor, the calculated KMO for Question 32 is 0.215 (see Appendix H) which is less than 0.5, and this means that the number of observations was not suitable for the EFA. As indicated before, since the respondents misinterpreted when answering Question 32, the variance was 0.000 and Cronbach's alpha was not calculated. Therefore, the Friedman test was used to rank these 12 influencing factors based on the collected data of Question 31 because these factors were common to both Question 31 and Question 32. Demand for environmentally-friendly services as an influencing factor was considered again in Friedman test because Question 32 included this factor.

5.5.2 Friedman test for ranking influencing factors

The Friedman test is used when the appropriate method for such comparison is the 'analysis of variance'. The Friedman test not only economises on the number of statistical procedures but also indicates if underlying factors or subgroups have contributed to any significant results (Pandit 2010). Thus, the Friedman test can be an appropriate test to rank the factors influencing environmental adoption which are common between Questions 31 and 32. Table 5.6 shows the statistics of the Friedman test which was done based on the original 12 influencing factors.

Table 5. 6 Friedman test

Amount of test statistic	Degree of freedom (DF)	P-value
114.753	11	0.000

According to Table 5.6, assuming the equivalent rank of influencing factors is not acceptable, thus, these factors can be ranked based. Friedman test was done to rank the original 12 influencing factors based on their mean rank (Table 5.7).

Table 5. 7 Ranked factors based on the Friedman test

Influencing factors	Mean rank	Rank
Governmental regulation	8.82	1
Increasing in fuel and energy prices	7.81	2
The potential for achieving a competitive advantage	7.72	3
Customers' pressure	7.56	4
Governmental support	7.14	5
Accumulation of new technologies	6.38	6
Social awareness	6.22	7
Demand for environmentally-friendly logistics services	6.19	8
Competitors' pressure	5.98	9
Company growing in size	4.85	10
Employees' interest in environmental activity adoption	4.77	11
Suppliers' pressure	4.57	12

Table 5.7 shows the mean for each influencing factor as well as the rank of each factor to identify the most and the least factors that influencing the sample of this study towards environmental adoption. Although some scholars such as Lorentz et al. (2011) consider governmental regulation and governmental support as a single governmental factor, others such as Lin and Ho (2011) and Isaksson (2012) considered them separately, but there is a lack of comparison for these two separated factors in the literature. Therefore, this study considers them separately to determine their importance and differences between them. The results of this study reveal that governmental regulation (first rank) is stronger than governmental support (fifth rank) because government regulations are compulsory and put direct pressure on companies towards environmental activity adoption.

Increasing in fuel and energy prices has the second rank showing that this factor is one of the most influential factors for environmental activity adoption in the sample of this study. Since transportation and freight forwarding, as well as storage and warehousing, are the main logistics services, use of energy-efficient vehicles and environmentally energy sources to reduce the fuel and energy costs are appropriate ways to mitigate the risk of increased fuel and energy prices.

The potential for achieving a competitive advantage is the third important factor which affects the sample in environmental activity adoption. Some factors such as the potential for achieving competitive advantage can be a stronger influence for leading companies that intend to create a competitive advantage through improving sustainable performance and being a market leader (Chan et al. 2012; Eloranta & Turunen 2015; Gao 2013; Lorentz et al. 2011). The results revealed that achieving a competitive advantage in market competitiveness is a significant motivation for companies to implement environmental activities as claimed by scholars (Salomone 2008). According to Isaksson (2012), integrating environmental aspects into logistics activities increase market share and help drives logistics service providers for being an environmental leader in the market (Liu et al., 2017; Jurksiene & Pundziene 2016). Moreover, investment in environmental initiatives stimulates the innovation development which leads to business efficiency (Tan et al., 2015) and major competitive advantage (Isaksson 2012; Seidel et al. 2009). When increasing market share and being a leader in the market provides companies with a competitive advantage, environmental logistics is a source of competitive advantages (Cucchiella et al. 2012). Therefore, the potential of environmental logistics for achieving a competitive advantage, as shown by the results of the Friedman test of this study, strongly motivate the sample to adopt the environmental activities.

The results of the Friedman test showed that customers' pressure achieved fourth place in this study. This shows that the expectation of customers who are aware of environmental responsibility is a significant influencing factor which positively affects the sample to adopt environmental activities as indicated by Seroka-Stolka (2014) and Isaksson (2012). The results of Friedman test showed that pressure from the aware customer is stronger than the pressure from competitors and suppliers and strongly motivates the sample for environmental adoption because adoption of the environmental initiative is a strategic tool and business opportunity attracting new, aware and interested customers (Lieb and Lieb 2010). Logistics companies' performance is based on an elevated understanding of customer requirements and is vital for achieving success for companies as well as for the whole supply chain

(Cucchiella, Koh, Walker, et al. 2012). In addition, leading-edge logistics service providers concentrate centrally on customer needs and are highly equipped to meet these (Kim & Lee 2012). Therefore, customers' pressure is a strong influencing factor toward environmental adoption, affecting the performance of logistics companies, especially leading-edge companies, within supply chains.

Accumulation of new technologies is a factor influencing environmental activity adoption (Chien & Shih 2007) which has approximately a midpoint (6.38) among the score 1-12. Similarly, social awareness had also a midpoint (6.22) among 1-12 scores. Demand for environmentally-friendly services and social awareness including the pressure of media, public authorities and society's perception of the company are clustered in a group as strong influencing factors (Lin et al. 2014; Salomone 2008). Although social awareness as well as its included items such as media pressure directly and indirectly (by increasing the awareness of customers) influence companies for environmental adoption, the results of Friedman test revealed that the pressure from aware customers with the fourth rank is stronger than social awareness because customers can directly affect the market share, sale volume and financial performance of companies. In addition, customers' demands and interests in regard to environmental initiatives in their purchasing of services have grown increasingly (Isaksson 2012). Consequently, logistics industries need to implement environmental activities to offer acceptable services to their highly aware customers.

As in the first run of EFA, demand for environmentally-friendly logistics services showed the least coefficient which had very close amount among the three components of EFA (Appendix H), it was eliminated for the second run of EFA according to the literature (Isaksson 2012), demand for environmental logistics services stems from social awareness and is more relevant to the pressure of future expectations and their consequences. The Friedman test placed it at the eighth rank after social awareness which confirmed the literature in terms of being it close to social awareness. The Friedman test also confirmed the credibility of removing it in the first rank of EFA and integrating it to social awareness.

Competitors' pressure is indicated as an important motivation for companies to implement environmental activities in the research by Dubey, Gunasekaran and Ali (2015) and Salomone (2008), while in this study it is ranked ninth among 12 factors. However, when existing rivals adopt environmental policies, it drives logistics companies to integrate environmental aspects into their activities to increase market share (Isaksson 2012) and even more, being an environmental leader in the market (Kim & Lee 2012). Existing rivals adopt environmental activities to attract aware customers and meeting customers' needs due to customers' pressure. Rivals' adopting environmental activities become a competitor pressure which motivates other companies' adoption. Therefore, customers' pressure is stronger than competitor pressure (confirmed by the results of Fridman test) which directly and indirectly push logistics companies for environmental adoption.

The company growing in size as an internal factor (Seroka-Stolka 2014) had the least effect (ninth and tenth rank, respectively) on environmental activity adoption. According to Porter's five forces model (Porter 2011; Porter 2008), competitors' strategies influence market. Competitors' strategies in terms of environmental activity adoption can also impact market and act as a pressure factor. Moreover, corporate social responsibility can affect a company’s marketing strategies (Dubey, Gunasekaran & Ali 2015) and influence market. The results showed that the influence of competitors’ pressure on the sampled logistics companies towards environmental activity adoption is not high.

Walker, Di Sisto and McBain (2008) and Salomone (2008) believe that supplier pressure cannot be a driving factor while Isaksson (2012) claims that pressure from suppliers can be an external key driver to adopt environmental activities. The results of the Friedman test indicate that suppliers’ pressure and employees’ interest in environmental activity adoption have the least effects on Australian logistics companies in adopting environmental activities among all twelve considered factors.

5.5.3 Means of influencing factors based on offered logistics services

Considering the means of influencing factors based on the types of the logistics services offered by companies revealed that the effects of these factors were variable based on the level of logistics companies because the means of these factors were more than three in each logistics service (Appendix K). For instance, the means of governmental regulation and increasing fuel and energy prices were just over four for all logistics services and this indicated that these two factors strongly affected all types of logistics companies (1PLs, 2PLs, 3PLs, 4PLs and 5PLs). However, some companies that only undertake freight forwarding and/or distribution (1PLs and 2PLs) were influenced by governmental regulation and increasing fuel and energy prices. This showed that other influencing factors did not have significant effects on 1PLs and 2PLs. The results showed that 3PLs, 4PLs and 5PLs were also influenced by customers’ pressure, although the influence of governmental regulation and increasing in fuel and energy prices on them is high towards environmental adoption. Some factors such as accumulation of new technology, the potential for achieving a competitive advantage and governmental support also had means of slightly more than three (Appendix K). Therefore, logistics companies with limited services adopt environmental activities when they are under pressure from the government through regulations or price policies about fuel and energy.

Lead logistics companies are not only affected by these factors but they are also influenced by customer pressure, the potential for achieving a competitive advantage and governmental support (Chan et al. 2012; Eloranta & Turunen 2015; Gao 2013; Lorentz et al. 2011; Salomone 2008). Leading-edge companies use environmental adoption as a business tool to be a leader in the market (Kim & Lee 2012). This study confirmed that leading logistics companies in the sample adopted environmental activities not only under governmental support and regulation but also, for the purpose of achieving success and competitive advantage in the market. Governmental regulation and the prices of fuel and energy are primary influencing factors toward environmental activity adoption for all types of logistics actors while when the capability and business level of a company's activities are increasing, the company offers environmental services to satisfy aware customers and being a leader in the market.

5.5.4 Influencing factors indicated by respondents

There are other influencing factors that influence environmental activity adoption in the sample logistics companies, as indicated by respondents in their answers to the qualitative question of this study. These factors can be grouped based on their context.

The first group includes factors in the competitiveness context such as wanting to be a leading-edge project logistics service provider and demonstrating words with action to become a brand differentiation and leader in the logistics industry. The second group are factors about responsibility, includes a strong desire to reduce landfill and recycle waste, and doing the right thing as a corporation through implementing the corporate strategy as a major player for further environmental adoption. Another group consists of financial factors such as profitability and financial payback encourage companies. For example, the respondents indicated that identifying a green fleet, which reduces operational cost and increases customer demand, can affect logistics companies over time to switch to more environmental adoption.

Risk factors are set in another group including potential business risk such as NDIS (National Disability Insurance Scheme) funding. Risk mitigation, environmentally-friendly and biodegradable alternatives for lubricants equate to significant risk reductions in potential environmental and worker impact. Risk management is an important factor within supply chains and according to Kwak et al. (2018), the risk within supply chain, could be stemmed from risk source, the level at which it occurs and subsequent risk nature from supply chain practitioners' perception. Since supply chain risk management is an important element, therefore, reduction in risks is another factor affecting environmental activity adoption.

Moreover, accessibility, fuel efficiency and the interest of the owner of a company in buying fuel-efficient vehicles can influence logistics companies toward environmental activity adoption. Development of global carbon markets (trading schemes) and auditing programs such as 'B Corporation' programs. A 'B Corporation' is a company which has been accredited for “meeting rigorous standards of social and environmental performance, accountability, and transparency” by the non-profit organisation B Lab (Stubbs 2017). B Lab promotes a global movement towards using ‘business as a force for good’, with the vision that businesses will compete to improve the world and create enduring prosperity (Stubbs 2017). There are currently over 2,000 B corporations worldwide, across 54 countries. Currently, there are 2,251 companies in more than 50 countries that have publicly disclosed their environmental information through the Carbon Disclosure Project (CDP) (Blanco, Caro & Corbett 2017). The CDP is an organisation based in the United Kingdom which supports companies and cities to disclose the environmental influences of major corporations (Blanco, Caro & Corbett 2017). Therefore, the result of the current study showed that the use of carbon auditing programs and corporate social responsibility influence the adoption of environmental activities.

However, one of the respondents indicated that implementing environmentally-friendly technology is expensive and its expense is a barrier to environmental activity adoption. Tacken, Sanchez-Rodrigues and Mason (2014) suggest high investment costs as a barrier to environmental logistics. Another of respondents believed that only the influence of government is substantial while increased fuel prices have little impact due to the costs of doing business being passed onto the consumer.

Although identifying and ranking influencing factors that motivate logistics companies in implementing environmental activities is an appropriate way to improve environmental adoption, determining the level of environmental adoption as well as determining the most and the least environmental activities have been undertaken are other appropriate ways to improve environmental adoption and understanding the obstacles towards it. Thus, the SRQ2 of this study investigates the environmental activities that have been undertaken by Australian logistics companies in the last five years and the analysis of the collected data will be represented in the following section.

5.6 Implemented environmental activities in the last five years

Since identifying the level of environmental adoption and interpreting the collected data is a gap in the literature (Lam & Dai 2015; Schaltegger et al. 2014), the respondents were asked to indicate which environmental activities have been implemented by their company in the last five years to answer SRQ2 as follows:

> ***SRQ2:*** *Which environmental activities have been undertaken by Australian logistics companies in the last five years?*

Figure 5.8 shows the most and the least implemented environmental activities in the last five years by the sample of this study. Only 1% of logistics companies did not choose to adopt any of these environmental activities and the reason may be is too much cost or they just do not care about the environment. Freight transport and distribution are logistics services offered by 70% to 80% of Australian logistics companies in the sample because these logistics services are the main activities carried out by even 1PLs. The environmental activities related to these services are optimisation of the distribution process and replacing old vehicles with energy-efficient types which had been implemented by 85% and 70% respectively of logistics companies in the last five years. It appears that approximately all respondent logistics companies, including 1PLs to 5PLs offering transportation and distribution, have adopted related environmental activities to these services. Therefore, these environmental-related activities are the main interventions within logistics companies' scope which have a substantial potential to prevent the environment from more damages.

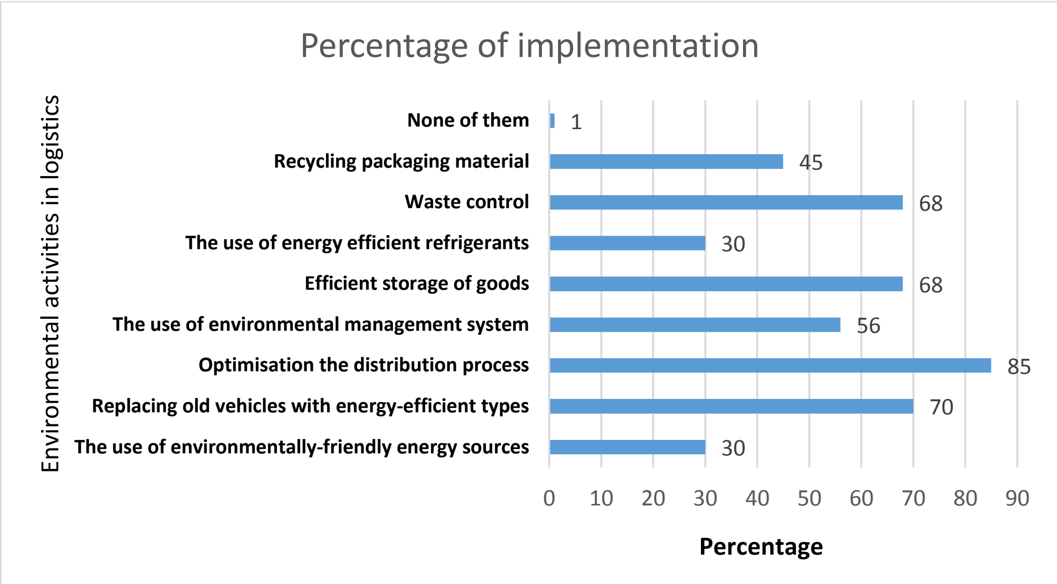

Figure 5. 8 Percentage of implemented environmental activities

Warehousing and storage service in third place is offered by around 70% of logistics companies, including 2PLs to 5PLs, in Australia. Efficient storage of goods is an environmental activity which is related to this service and has been adopted by 68% of logistics companies and can, therefore, be another important activity to protect the environment. The use of energy-efficient refrigerant is another environmental-related activity to this service that has been implemented by 30% of logistics companies. This means that only less than half the number of warehouses use energy-efficient refrigerant. The fourth and fifth rank belongs to waste control and the use of environmental management activities and they have about 67% and 56% of implementation.

Packaging and labelling is another logistics service which is offered by around one-third of Australian logistics companies in the sample. Recycling packaging material is environmental-related activity in this service which has been implemented by 45% of companies in the last five years. This shows that all companies offering this service recycle their material. This means that all companies with different services have implemented this environmental activity. Thus, implementing this activity does not depend on the type of offered services or the type of logistics service providers (1PLs to 5PLs).

Each environmental activity may have the potential to provide an opportunity for the company to be a leader in the market. Thus, those activities that are not implemented by many of the sample may have more potential to provide a company with achieving a competitive advantage through its implementation. For instance, the optimisation of the distribution process is implemented by more than four-fifths of logistics companies of the sample. Therefore, this environmental activity may have not sufficient potential to provide a company with a competitive advantage because it has been implemented by many companies and implementing it cannot help the company to be a leading-edge company in the market. In addition, those companies who have still not implement the most implemented environmental activities such as the optimisation of the distribution process, have lagged the market.

Waste control, replacing old vehicles with energy-efficient types and efficient storage of goods have been implemented by more than two-thirds of logistics companies and are set in the second to fourth rank of implementation. Recycling packaging material has been implemented by 45% of companies and it may still provide 2PLs to 5PLs with a chance to achieve a competitive advantage. The use of energy-efficient refrigerants, which is related to warehousing services, implemented by less than one-third of companies. If this activity has the potential to improve the performance of a company, it may provide a company with a competitive advantage.

The results showed that 30% of all types of logistics companies use environmentally-friendly energy sources for their companies and warehouses. The use of environmentally-friendly energy sources is ranked as the eighth position and may be an opportunity for those logistics companies that want to be a leader in the market because this activity is not only implemented by 30% of logistics companies but also, according to the literature (Lam & Dai 2015; Lin & Ho 2011; Awasthi, Chauhan & Goyal 2010) has the potential to improve energy and cost savings. Therefore, it can be a means of achieving a competitive advantage if it empirically improves some measures of sustainable performance such as cost saving which will be investigated in the next analysis chapter.

5.6.1 Identifying other implemented environmental activities

To find other implemented environmental activities, respondents were asked to indicate which other activities have been implemented by their companies in the last five years. Although the use of reflective paint on the warehouse roof was indicated by a general manager from a logistics company that offers all logistics services (5PLs) as an activity to have lower air conditioner costs, this environmentally-friendly activity could be implemented by 1PLs to 6PLs. Use of sensor-operated and LED lighting for warehouses are other environmental activities for having environmental warehousing. Conducting the process of going carbon neutral for aiming to offset scope 1, 2 and 3 emissions was suggested by some respondents. One of the managing directors from a company which offers freight transport and heavy haulage suggested retaining older and well-maintained trucks as an environmentally-friendly activity. The manager indicated that they are more fuel-efficient and more reliable than new trucks because disabling emission controls on a truck is a useful way to achieve better fuel economy and significantly better reliability (a truck uses fuel 10–20% less than diesel now and runs 20% cooler under identical conditions compared with others). This respondent believed that retaining older and well-maintained trucks that are running emission controls means they require fewer repairs, fewer spare parts and less oil consumption. However, if it disables emission control, it will be illegal in Australia.

The analysis of the level of implementing environmental activities provided information on the potential of each environmental activity to make opportunities for companies in the sample. However, this information can be useful when the potential of these activities to improve sustainable performance are investigated. Identifying those environmental activities which have significant effects on improving sustainable performance and which have been less implemented by logistics companies may be an appropriate means of achieving a competitive advantage. Therefore, companies can seek their new opportunities for achieving a competitive advantage by implementing environmental activities related to the services offered by them which may have positive effects on sustainable performance. The next chapter will analyse the effects of these environmental activities on improving sustainable performance. Comparing the most influential environmental activities for improving sustainable performance with their level of implementation may provide information on the potential of each environmental activity to create a competitive advantage for a company in the market.

5.7 Summary

This chapter presented the descriptive statistics and quantitative data analysis and discussed the qualitative and quantitative outcomes in terms of questions related to the left and middle sides of the conceptual framework to answer SRQ1 and SRQ2. Firstly, an EFA was conducted to answer SRQ1 which found the greatest factors influencing environmental activity adoption for Australian logistics companies which are grouped in three components. The results of the EFA indicated there are three components influencing environmental adoption. The Friedman test was used based on original 12 influencing factors to rank them and showed that governmental regulation, increasing in fuel and energy prices, as well as the potential for achieving a competitive advantage, had the first to third ranking respectively. Analysis of a qualitative question about other factors influencing environmental activity adoption identified new drivers and barriers towards environmental activity adoption. Finally, the descriptive and categorical analysis related to the most implemented environmental activities in Australian logistics were represented to answer SRQ2 in section 5.6 which showed the percentages of implementing environmental activities in the sample and suggested new environmental activities which indicated by respondents. Thus, the contributions of this study in this chapter are:

- Providing a table as the road map of Chapter 5 including the sections in the chapter, survey question number covering RQs, investigated variables, used statistics tests with the reasons for using them.
- Analysis and discussion on the demographic questions including separately analysis and comparison to the other demographic questions.

- Categorising and ranking factors influencing environmental adoption for the first time in the Australian logistics industry.
- Identifying the most and the least influencing factors based on the offered logistics services.
- Identifying new influencing factors indicated by respondents.
- Identifying the frequency of implemented environmental activities in the Australian logistics industry over the last five years.
- Suggesting new environmental activities indicated by respondents.

CHAPTER SIX: DATA ANALYSIS AND DISCUSSION: ENVIRONMENTAL ACTIVITIES AND SUSTAINABLE PERFORMANCE

6.1 Introduction

This chapter reports the results of the web-based survey to answer the secondary research question three (SRQ3) and the primary research question (PRQ) of this study. The objective of this chapter is to investigate the effects of implementing environmental activities on improving sustainable performance for Australian logistics companies as well as prioritising the environmental activities with the most potential to improve the measures of sustainable performance in Australian logistics to answer the SRQ3 and PRQ. Table 6.1 shows the road map of this chapter. Table 6.1 explains which section of this chapter answers the research questions of this study. This table also shows the investigated variables, statistics tests with the reasons for using them as well as the relevant survey questions for each research question.

This chapter consists of two main sections. Section 6.2 presents the results of a t-student test which investigates the relationship between implementing environmental activities and improving sustainable performance. Section 6.3 explains the results of the analytic hierarchy process (AHP) which was used to rank the several dimensions and measures of sustainable performance as well as prioritising the environmental activities to answer the SRQ3 and PRQ of this study in section 6.4. Section 6.5 explains the comparison of 1PLs to 5PLs about environmental activities.

Table 6. 1 Road map of Chapter 6

Section in this chapter	Survey questions	Research question	Variables (section of the conceptual framework in Figure 3.2)	Statistics test	Reason
6.2	7–30	SQR3	Environmental and sustainable performance measures (middle and right sections)	t-student test	Investigating the effects of activity on sustainable performance
6.3	35–46	SRQ3	Sustainable performance measures (right side)	AHP	Pairwise comparison and prioritising dimensions and measures of sustainable performance
6.4	7–30 and 35–46	SRQ3 and PRQ	Environmental activities and sustainable performance measures (middle and right sections)	Integrating t-student test and AHP	Prioritising environmental activities in logistics
6.5	3, 7–30	-	Environmental activities and sustainable performance measures (middle and right sections)	Integrating t-student test and the results of demographic question about offered logistics services	Comparing the viewpoints of 1PLs to 5PLs about environmental activities

6.2 Environmental activities and sustainable performance

The literature on sustainable performance and environmental activity adoption in logistics was discussed in Chapters 2 and 3 respectively. When improving sustainable performance as a means of achieving a competitive advantage (Sigalas & Pekka Economou 2013; Sigalas, Pekka Economou & Georgopoulos 2013), determining the effects of environmental activity implementation on improving sustainable performance may encourage or discourage logistics companies to adopt environmental activities. Strategies with social and environmental dimensions will become increasingly significant in developing a competitive strategy in highly competitive markets (Schulz et al. 2016).

Developing strategies in terms of adopting environmental activities may create a competitive advantage for logistics companies in the modern market which is affected by sustainability. Investigating the effects of implementing environmental activities in logistics on improving sustainable performance as well as prioritising the environmental activities based on the degree of their effect in improving the sustainable performance provide managers with deep insight. Therefore, this section investigates the survey data used to answer the SRQ3 and PRQ of this study. As developed from the literature review, eight environmental activities of relevance to the logistics industry, were included in the questionnaire.

In each of the following sections, the effects of implementing environmental activities on the measures of sustainable performance are explored to indicate the environmental activities with the most and the least influence on improving sustainable performance. This study uses the t-student test because it can be used when two sets of data are significantly different from each other (Tombesi et al. 2015). Since environmental activities and sustainable performance (two sets of data in this study) are independent variables and the relationship between them needed to be investigated, the t-student test was used, as described in this section. The number of environmental activities is eight and the number of measures is nine. Thus, this section needs to consider 72 hypotheses (see Appendix B). These hypotheses are used for each of the other activities and to do so only the name of activity needs to be changed. To avoid repetition, the following hypothesis is represented as an example.

Hypothesis 1: The use of environmentally-friendly energy sources (such as solar power or wind power) improves the company's market share.

$$\begin{cases} H0: & \mu = 3 \\ H1: & \mu \neq 3 \end{cases}$$

H0: The null hypothesis (μ is the mean of responses' scores)

H1: The alternate hypothesis

The null hypothesis states that the sample means are all equal and a p-value shows the probability of collecting data from a sample by chance and this can be a decimal and vary from 0% to 100% (Tombesi et al. 2015). A low p-value indicates that the data did not occur by chance. In most cases, a p-value of 0.05 (5%) indicates that the data are valid (Tombesi et al. 2015). If the p-value is less than or equal to the significance level, the null hypothesis (*H*0) is rejected and the conclusion is made that not all of the sample means are equal. If the p-value is greater than the significance level, it means that the amount of evidence is not sufficient to reject the null hypothesis and the sample means are all equal. Each interval is a 95% confidence interval for the mean of a group. There is 95% confidence that a group mean is within the group's confidence interval.

In this study, when the p-value is more than 0.05 (α=0.05), the activity does not have a significant effect on the investigated measure with a 95% level of confidence (Tombesi et al. 2015). If the p-value is less than 0.05 (α=0.05), the effect of the activity on the measure is significant. Since a Likert scale (1–5) has been used to answer these questions, the activities with a higher score than the mean value of the test (3 value) are introduced as effective activities. When the confidence interval of the difference 95% for (μ-3) shows positive value, $\mu>3$ is the reason for rejection of H0 which shows that the activity significantly affects the measures (Tombesi et al. 2015). The following eight sections discuss the results of t-student tests for each environmental activity. The p-value and confidence interval of the difference of 95% in the next sections are used to indicate the significant or insignificant effects of each environmental activity on each measure of sustainable performance.

6.2.1 The use of environmentally-friendly energy sources

Table 6.2 shows the results of the t-student test to find which measures of sustainable performance are improved by the use of environmentally-friendly energy sources (hypotheses 1–9 in Appendix B). The p-value for some measures is less than $\alpha=0.05$ and the confidence interval of the difference 95% of (μ-3) for these measures has a positive value which shows that the hypothesis of $\mu>3$ is acceptable in the level $\alpha=0.05$. Therefore, the effects of the use of environmentally-friendly energy sources such as solar and/or wind power on improving these measures (highlighted rows of the table) are significant.

According to Table 6.2, cost savings is the only measure of the economic dimension improved by this activity because the p-value is less than 0.05 and the confidence interval of the difference 95% of (μ-3) in the level of ($\alpha=0.05$) is positive. Since improving cost savings results in increasing profits, the theoretical link between implementing this activity and financial benefits is practically accepted. Although the use of environmental energy sources has high upfront costs, it benefits companies through cost savings in the long term. The results show that the effects of this activity on sales volume and market share are not significant because the p-value for market share is more than 0.05. Although the p-value for sales volume is less than 0.05, the use of environmentally-friendly energy sources does not have a significant impact on sales volume because the confidence interval of the difference 95% of (μ-3) in the level of (α=0.05) has a negative value.

Table 6. 2 Environmentally-friendly energy sources and sustainability

	Test Value = 3					
T-test	T-value	Degree of freedom	P-value	Mean difference from 3	Confidence interval of the difference 95%	
					Lower	Upper
Market share	-1.851	72	0.068	-0.287	-0.597	0.022
Cost savings	3.077	73	0.003	0.527	0.185	0.868
Sales volume	-2.458	72	0.016	-0.369	-0.669	-0.069
Material usage	1.239	69	0.220	0.185	-0.113	0.484
Energy consumption	3.067	69	0.003	0.528	0.184	0.872
Pollution control	7.278	69	0.000	1.085	0.788	1.383
Work safety and labour health	.894	65	0.375	0.136	-0.168	0.441
Employee satisfaction	2.818	65	0.006	0.378	0.110	0.647
Community support	5.408	65	0.000	0.772	0.487	1.058

Although this activity internally increases the financial performance through improved cost savings, it cannot significantly provide companies with the financial benefits which are provided from customers' and market demand. The effects of implementing this activity on environmental measures are more than the economic dimension because it also improves energy consumption and pollution control. Improving energy consumption means a reduction in the use of energy sources apart from environmentally-friendly types which in turn leads to reduced pollution. Reduction in energy consumption decreases the payments for electricity bills which improves cost savings. In addition, companies can freely produce and save all or some part of their required energy from the environment by implementing this activity which increases cost savings. Therefore, implementing this environmental activity, directly and indirectly, provides companies with financial benefits through cost savings. The results confirm that the effect of this activity on material usage is not significant (p-value > 0.05) because the environmental energy sources are those renewable sources such as solar or wind power which do not produce or use fuels or materials.

From the social dimension of sustainability, the influence of implementing this activity on improving work safety and labour health is not significant because the p-value is more than 0.05 for this measure. However, some scholars such as El-Amary et al. (2018) claim that environmental energy sources improve health and safety because they decrease the rate of pollution and harmful emissions. The results of the current study show that although the use of environmentally-friendly energy sources improves pollution control, it does not have a significant influence on work safety and labour health. This means that the results do not show a strong relationship between decreased pollution and increased work safety and labour health.

However, employee satisfaction and community support are the measures of sustainable performance that are improved by using environmentally-friendly energy sources. Community support is improved because the use of environmental energy sources shows corporate social responsibility for protecting the environment. It also improves employee satisfaction because there are some employees who are interested in environmental activity adoption. Increase in the satisfaction of employees improves their performance and this can provide companies with several advantages and financial benefits. According to Lorentz et al. (2011), enhancement of the image of the corporation and satisfying environmentally aware customers, media and communities are other benefits which can be attributed to environmental activity adoption. Having support from environmentally aware customers and communities enhances a company's reputation, giving it a good image, and a good reputation as a marketing tool can provide the company with advantages in the market. Therefore, the use of environmentally-friendly energy sources can act as a tool to enhance the company's reputation and bring the communities' support and benefits.

Opening up new markets, improved relations with other communities, increased brand recognition, attracting media coverage and inclusion in ethical investment funds as well as improved customer loyalty, especially for those customers with a social conscience, are other advantages which can stem from improving community support (Benn, Edwards & Williams 2014; Tai & Chuang 2014). The results of this study show the direct positive effects of using environmentally-friendly energy sources on improving community support and, according to the literature, improving community support can increase market share and sales volume. However, the results do not show a significant effect of this activity on improving market share and sales volume.

Moreover, stakeholders, employers and employees have a better feeling when a business is interested in these partnerships. It can also improve their performance and loyalty which leads to profits. The chance of better recruitment of well-educated and skilled workers is also increased by enhanced reputation. Therefore, when this activity improves community support, a company achieves several advantages which can help it to be successful in the market. These benefits can help a company to achieve a competitive advantage in the market. This shows that the use of environmental energy sources directly or indirectly improves sustainable performance which can provide a company with a competitive advantage.

Since the survey data were collected from those holding various titles within management, this study also investigated the effect of position variable on environmental activities. A one-way analysis of variance (ANOVA) test was used in this study because it is a statistical method used to determine whether there are statistical differences among the means of independent groups in a sample (Granato, de Araújo Calado & Jarvis 2014). ANOVA uses F-tests to statistically test the equality of means which is a ratio of two variances. F-statistics are based on the ratio of mean squares which is an estimate of population variance that accounts for the degrees of freedom (DF) used to calculate that estimate. In one-way ANOVA, the F-statistic is this ratio:

F = variation between sample means/variation within the samples

H0: $\mu_{1i} = \ldots = \mu_{6i}$

H1: Assume the opposite of *H0*

In the above assumption, μ_{ij} is defined as the mean of variable i (each measure of sustainable performance) in the level j of position variable related to each environmental activity. The null hypothesis (H_0) is that the mean values do not differ; the alternative (H_1) is that they do differ. If the p-value is more than alpha (α= 0.05), the null hypothesis is accepted. Otherwise, *H1* is accepted which states that there is a significant difference between different levels of positions for variable i. The results of the ANOVA test (see Appendix J) show that the effect of position on the measures of sustainable performance is not significant for the use of environmental energy sources because all the p-values are more than 0.05. This test was conducted to determine the effect of position variable on the relationship between each environmental activity and the measures of sustainable performance and the results related to each activity are explained in the section of each environmental activity separately.

6.2.2 Replacing old vehicles with energy-efficient vehicles

Replacing old vehicles with energy-efficient types is an important activity of environmentally-friendly transportation. Nine hypotheses (10–18 in Appendix B) were developed to investigate the effects of implementing this activity on improving sustainable performance. According to Table 6.3, the impact of this activity on improving cost savings is significant (p-value =0.000) although this activity cannot significantly improve other considered measures of economic performance because the p-value is more than 0.05 for both market share and sales volume. In terms of these measures, the confidence interval of the difference 95% of (μ-3) in the level of (α=0.05) has negative value.

In terms of environmental impacts, implementing this activity improves all the measures including material usage, energy consumption and pollution control because the p-value is 0.000 for all these measures. Therefore, this activity is an effective action to protect the environment through a reduction in fuel consumption which makes air pollution such as carbon dioxide. According to some scholars such as Giordano, Fischbeck and Matthews (2018), new vehicles, including energy efficient types, reduce greenhouse gas (GHG) emission by 25%. In addition, the results of this study confirmed that improving material usage and energy consumption benefits companies with an increase in cost savings which results in enhanced financial performance. Moreover, when a company carries out its responsibilities in terms of protecting the environment, it provides the company with enhanced financial performance.

Work safety and labour health, employee satisfaction and community support are all the measures of social performance which can be improved by implementing this activity (p-value = 0.000). Improving work safety and labour health results in increasing the well-being, satisfaction and motivation of the workforce as well as reducing workplace stress (Loeppke et al. 2015) because it demonstrates that the company is being responsible in looking after its employees. Increased satisfaction may improve performance. In addition, since improving the safety and the health of employees reduces the risk of accidents and injuries in workplaces, it plays a vital role in decreasing insurance and treatment costs. Thus, cost savings, as a measure, is indirectly increased by improving work safety and labour health. Although implementing this activity shows that its positive effects on other dimensions have more than an economic dimension, improving social and environmental performance indirectly improves cost savings as a measure of economic performance.

Therefore, replacing old vehicles with energy efficient types is an effective activity to have environmentally-friendly transportation that improves the company’s sustainable performance. This activity not only protects the environment, but it also enhances the social performance of the company in both the internal and external environment. Implementing this activity, directly and indirectly, results in cost savings by improving other measures of environmental and social performance.

Table 6. 3 Replacing old vehicles with energy-efficient types and sustainability

	Test Value = 3					
T-test	T-value	Degree of freedom	P-value	Mean difference from 3	Confidence interval of the difference 95%	
					Lower	Upper
Market share	0.928	73	0.357	0.135	-0.155	0.425
Cost savings	7.459	73	0.000	1.094	0.802	1.387
Sales volume	0.351	72	0.726	0.054	-0.256	0.365
Material usage	4.460	69	0.000	0.671	0.371	0.972
Energy consumption	7.490	69	0.000	1.085	0.796	1.375
Pollution control	8.534	69	0.000	1.214	0.930	1.498
Work safety and labour health	5.350	65	0.000	0.742	0.465	1.019
Employee satisfaction	10.436	65	0.000	1.196	0.968	1.426
Community support	7.822	65	0.000	0.969	0.722	1.217

The results of the ANOVA test (Appendix J) show that the effect of the position title of the respondent on the measures of sustainable performance is not significant for this environmental activity because all the p-values are more than 0.05. This means that there is no significant difference between the collected data among several positions of respondent such as chief executive officer, managing director and general manager.

6.2.3 Optimisation of distribution process

Table 6.4 shows the results of the t-student test investigating the effects of implementing optimisation of the distribution process through better routing and scheduling on improving sustainable performance (hypotheses 19–27 shown in

Appendix B). This is one of the environmental activities that can be implemented to have environmentally-friendly transportation. This activity has the potential to improve all nine measures of sustainable performance because the p-value is 0.000 and the confidence interval of the difference 95% of (μ-3) in the level of (α=0.05) is positive which show that the hypothesis of $\mu>3$ in the level of (α=0.05) is acceptable for all measures of sustainable performance. Thus, this is one of the most important environmental activities in logistics that improve economic, environmental and social performance simultaneously.

Table 6. 4 Optimisation of distribution and sustainability

T-test	Test Value = 3					
	T-value	Degree of freedom	P-value	Mean difference from 3	Confidence interval of the difference 95%	
					Lower	Upper
Market share	6.831	73	0.000	0.932	0.660	1.204
Cost savings	12.569	73	0.000	1.432	1.205	1.659
Sales volume	7.774	73	0.000	0.986	0.733	1.239
Material usage	8.925	69	0.000	1.057	0.820	1.293
Energy consumption	11.236	69	0.000	1.271	1.046	1.497
Pollution control	8.400	69	0.000	1.171	0.893	1.449
Work safety and labour health	10.708	65	0.000	1.121	0.912	1.330
Employee satisfaction	11.571	65	0.000	1.151	0.953	1.350
Community support	3.628	65	0.001	0.515	0.231	0.798

The results of the demographic questions suggest that nearly 80% of Australian logistics companies offer freight transport and distribution services and these two logistics services contribute to air emission. Thus, implementing this environmental activity by logistics companies has positive effects on the environment as well as improving all considered measures of sustainable performance. The optimisation of the distribution process is a more effective method of improving sustainable performance compared to replacing old vehicles, which is another activity from the environmentally-friendly transportation group. The differences between them are mainly related to the effects of the optimisation distribution process on improving market share and sales volume. Although these two activities improve all measures of social and environmental performance, the direct positive effects of optimisation of distribution process on improving economic performance are significantly apparent because this activity improves all economic measures. Since the main logistics services carried out by most types of logistics service providers are freight forwarding and distribution, environmentally-friendly transportation plays a vital role for them in improving their sustainable performance as well as protecting the environment. Replacing old vehicles and optimisation of distribution process are two effective activities of environmentally-friendly transportation. According to Sanchez-Rodrigues, Potter and Naim (2010), supply chain uncertainty has a significant effect on transport efficiency and inefficient freight transportation increases CO2 emissions in supply chain. Thus, optimisation the distribution process and the use of energy-efficient vehicles are important because these activities decrease the uncertainty and pollution in supply chains (Sanchez-Rodrigues, Potter & Naim 2010). The role of distribution optimisation is more important because it has more potential to improve economic performance which is the most important from a manager's viewpoint (the reasons for this will be explained in section 6.3 on pairwise comparison). Distribution optimisation helps logistics companies to increase sales volume and market share. Thus, this activity is the most economic environmental activity among several activities that are considered in this study.

Optimisation of the distribution process through better routing and scheduling prevents companies from wasting time, fuel and energy consumption (Lam & Dai 2015; Lorentz et al. 2011; Büyüközkan & Berkol 2011). Consequently, they can offer more services at the same time with less material and energy usage which results in increasing sales volume, market share and cost savings. Since this activity decreases waste of fuel and energy consumption through better routing, it decreases pollution, noise and the risks of an accident. According to Zhang et al. (2014), implementing this activity can enhance the performance of logistics companies and the results of this study confirmed that better routing and scheduling provides employees with higher satisfaction. Higher satisfaction results in higher performance (Bhat & Darzi 2016; Kim, Li & Brymer 2016) and higher performance is a means of achieving a competitive advantage (Sigalas & Pekka Economou 2013; Sigalas, Pekka Economou & Georgopoulos 2013). Time scheduling also provides customers with higher satisfaction because reduced delivery time is an important factor for satisfying customers (Chan, Liu & Zhang 2018; Fernandes & Pedroso 2017). Reduced time delivery and customers' trust and loyalty result in higher market share and sales volume (Bucovetchi, Simioana & Stanciu 2017; Yoon, Lee & Schniederjans 2016) and this means increasing profitability and achieving a competitive advantage.

The results of the ANOVA test (Appendix J) suggest that the effects of the position of the respondent (manager) on work safety and labour health and employee satisfaction for this activity are significant because the p-value is less than 0.05 for these measures. The effect of respondent's position on other measures of sustainable performance is not significant. All the respondents with a managing director title agreed that optimisation of the distribution process improves employees' satisfaction and 70% of managing directors stated that this environmental activity strongly improves employee satisfaction. Approximately 90% of general managers and logistics managers stated that this activity has a positive effect on improvement in employee satisfaction and 30% of these two titles strongly believed this statement. Other titles had diverse opinions and two-thirds of chief executive officers disagreed. In terms of improving work safety and labour health, all managing directors confirmed the positive effects of distribution optimisation on improving work safety and labour health and more than 60% of them strongly believed this statement. Similarly, all general managers and more than 90% of logistics managers confirmed the relationship between the distribution optimisation and work safety and labour health. One-third of them indicated that the effect of distribution optimisation on improving work safety and labour health is strong. The chief executive officers had diverse responses and opinions about the effect of this activity on improving work safety and labour health. The possible reason is that chief executive officers may have not sufficient experience and direct connections with the operations level of companies.

6.2.4 Use of environmental management system

Table 6.5 shows the results of the t-student test to find the effects of the use of environmental management system such as ISO standards on the nine measures of sustainability (hypotheses 28–36 shown in Appendix B). According to Table 6.5, the impact of the use of the environmental management system on all measures are significant except employee satisfaction. The p-value is more than 0.05 for employee satisfaction, and the confidence interval of the difference 95% of (μ-3) at the level of α=0.05 is also negative for employee satisfaction. Environmental management systems not only improve environmental performance, but they also have the potential to significantly improve economic performance. However, the use of environmental management systems needs investment. This environmental activity provides companies with financial advantages such as improvement in market share, cost savings and sales volume. This activity also has a positive effect on improving work safety and labour health as well as community support. The advantages which stem from these improvements were discussed in previous sections related to other activities. Therefore, this activity has the potential to provide a company with a competitive advantage through the improvement of sustainable performance. The results of the ANOVA test (Appendix J) suggest that the effects of respondents' position titles on the measures of sustainable performance for this activity are not significant.

Table 6. 5 Environmental management system and sustainability

T-test	Test Value = 3					
	T-value	Degree of freedom	P-value	Mean difference from 3	Confidence interval of the difference 95%	
					Lower	Upper
Market share	3.527	73	0.001	0.513	0.223	0.804
Cost savings	2.763	72	0.007	0.383	0.107	0.660
Sales volume	2.599	72	0.011	0.356	0.083	0.629
Material usage	3.194	68	0.002	0.478	0.179	0.777
Energy consumption	2.907	68	0.005	0.434	0.136	0.733
Pollution control	3.265	68	0.002	0.507	0.197	0.817
Work safety and labour health	3.335	65	0.001	0.530	0.213	0.848
Employee satisfaction	1.449	65	0.152	0.227	-0.086	0.540
Community support	3.139	65	0.003	0.530	0.193	0.868

6.2.5 Efficient storage of goods

Efficient storage of goods is one of the activities from the environmental warehousing and storage group. Hypotheses 37–45 were developed to investigate the effects of implementing this activity on improving sustainable performance (Appendix B). Table 6.6 shows that the effects of efficient storage of goods on improving all measures of sustainability are significant except for community support because the p-value for this measure is more than 0.05. This activity improves economic performance and environmental performance more than social performance. This activity is one of the most effective activities after optimisation of the distribution process among activities considered in this study.

Table 6. 6 Efficient storage of goods and sustainability

	Test Value = 3					
T-test	T-value	Degree of freedom	P-value	Mean difference from 3	Confidence interval of the difference 95%	
					Lower	Upper
Market share	5.401	73	0.000	0.729	0.460	0.999
Cost savings	9.812	73	0.000	1.189	0.947	1.431
Sales volume	5.547	72	0.000	0.698	0.447	0.949
Material usage	5.043	69	0.000	0.757	0.457	1.057
Energy consumption	4.381	69	0.000	0.671	0.365	0.977
Pollution control	3.801	69	0.000	0.571	0.271	0.871
Work safety and labour health	5.719	65	0.000	0.818	0.532	1.104
Employee satisfaction	5.880	65	0.000	0.788	0.520	1.055
Community support	.701	65	0.486	0.106	-0.196	0.408

The results of the ANOVA test (Appendix J) suggest that the effect of respondents' title is only significant on work safety and labour health. Two-thirds of the respondents with chief executive officer titles disagreed that implementing this activity can improve work safety and labour health while 90% of operational managers, 85% of managing directors, 70% of general managers and 60% of logistics managers believed that this effect is significant. Thus, those managers who work directly with labourers in logistics operations and warehouses may have more insight into the significance of the effect of implementing this activity on improving work safety and labour health.

6.2.6 Use of energy-efficient refrigerant

The results of the t-student test in Table 6.7 shows that the effect of the use of energy-efficient refrigerants (another activity of environmental warehousing) on all measures are not significant (hypotheses 46–54 shown in Appendix B). For some measures such as cost savings, material usage, energy consumption and pollution control, the p-value is more than 0.05 and the confidence interval of the difference 95% of (μ-3) in the level of α=0.05 have negative value. Thus, the hypothesis of μ=3 is acceptable for the above measures and this means that the use of energy-efficient refrigerants does not improve those measures. The effects of the use of energy-efficient refrigerants on market share and sales volume are also insignificant because the confidence interval of the difference 95% of (μ-3) in the level of α=0.05 are negative. Therefore, the effects of implementing this activity on improving 'market share' and 'sales volume' are not significant.

Therefore, the use of energy-efficient refrigerants is the least influential environmental activity among considered activities as it was found to have no positive effects on improving sustainable performance. Although some scholars (Lorentz et al. 2011; Oh et al. 2016; Qyyum & Lee 2018; Welford 1999) mention that this activity decreases energy consumption and consequently increases cost savings and pollution control, the practical results of this study reveal that this activity has no significant effect on improving these measures for sampled companies. The possible reason for these unexpected results to compare with literature could be relevant to the type of services offerred by sample. For example, they may not offer chill distribution services to their customers or they may have not replaced their old refrigerants with the energy-efficient types, yet. Moreover, sampled companies may use energy-efficient refrigerants but they may not aware of the benefits such as reduced energy consumption and costs savings because they may not measure and assess these benefits.Therefore, this activity may not be an important and effective activity for improving performance and achieving a competitive advantage for sampled logistics companies. The results of the ANOVA test (Appendix J) suggest that the effects of respondents' titles on the measures of sustainable performance for this activity are not significant.

Table 6. 7 Use of energy-efficient refrigerants and sustainability

T-test	Test Value = 3					
	T-value	Degree of freedom	P-value	Mean difference from 3	Confidence interval of the difference 95%	
					Lower	Upper
Market share	-2.049	72	0.044	-0.356	-0.702	-0.009
Cost savings	1.711	72	0.091	0.328	-0.054	0.712
Sales volume	-2.292	71	0.025	-0.389	-0.727	-0.050
Material usage	-1.320	68	0.191	-0.261	-0.655	0.133
Energy consumption	1.693	69	0.095	0.371	-0.066	0.809
Pollution control	1.000	69	0.321	0.214	-0.213	0.642
Work safety and labour health	-0.310	65	0.757	-0.060	-0.451	0.329
Employee satisfaction	-0.549	65	0.585	-0.106	-0.492	0.279
Community support	-1.157	65	0.252	-0.227	-0.619	0.165

6.2.7 Waste control

Waste control is an environmental activity related to the recycling group. Table 6.8 shows the result of the t-student test to investigate the effects of this activity on the measures of sustainability (hypotheses 55–63 in Appendix B). According to the results of Table 6.8, the effects of this activity on all measures are significant except for market share and sales volume. Waste control is an environmental activity that improves the economic dimension only through increased cost savings. However, this activity has the potential to provide a company with social and environmental competitive advantages which can yield financial benefits for logistics companies.

Table 6. 8 Waste control and sustainability

T-test	Test Value = 3					
	T-value	Degree of freedom	P-value	Mean difference from 3	Confidence interval of the difference 95%	
					Lower	Upper
Market share	0.564	73	0.574	0.081	-0.205	0.367
Cost savings	5.829	72	0.000	0.835	0.549	1.121
Sales volume	-0.591	72	0.556	-0.082	-0.359	0.195
Material usage	6.063	69	0.000	0.885	0.594	1.178
Energy consumption	3.482	69	0.001	0.543	0.232	0.854
Pollution control	6.622	69	0.000	0.971	0.678	1.264
Work safety and labour health	3.858	65	0.000	0.515	0.248	0.782
Employee satisfaction	4.267	65	0.000	0.575	0.306	0.845
Community support	5.544	65	0.000	0.848	0.543	1.154

The results of the ANOVA test (Appendix J) suggest that the effect of respondents' title is only significant on market share. All chief executive officers disagreed with the significance of the effect of waste management on improving market share and one-third of them even strongly disagreed with this statement. However, around 80% of general managers, as well as more than 60% of managing directors, agreed with it and one-third of them strongly believed it. The opinions of other managers in several positions are various about the effects of waste management on improving market share.

6.2.8 Recycling packaging materials

Recycling packaging material is another activity of the recycling group. Nine hypotheses were developed (Appendix B) to investigate the effects of implementing this activity on improving sustainable performance. According to Table 6.9, the effects of recycling packaging material on some measures including cost savings, material usage, energy consumption, pollution control and community support are significant. Since the p-values are less than 0.05 and the confidence intervals of the difference 95% for (μ-3) in the level of α=0.05 are positive, the hypothesis of μ>3 in the level of α=0.05 for these measures is acceptable and this means that implementing this activity improves the above measures.

Table 6. 9 Recycling packaging materials and sustainability

T-test	Test Value = 3					
	T-value	Degree of freedom	P-value	Mean difference from 3	Confidence interval of the difference 95%	
					Lower	Upper
Market share	0.536	74	0.593	0.080	-0.217	0.377
Cost savings	5.171	73	0.000	0.675	0.415	0.936
Sales volume	-.790	72	0.432	-0.109	-0.386	0.167
Material usage	4.910	69	0.000	0.757	0.449	1.065
Energy consumption	2.038	69	0.045	0.300	0.006	0.594
Pollution control	5.409	69	0.000	0.843	0.532	1.154
Work safety and labour health	0.485	65	0.629	0.075	-0.236	.387
Employee satisfaction	1.835	65	0.071	0.288	-0.025	0.601
Community support	4.071	65	0.000	0.682	0.347	1.016

The p-value for market share, sales volume, work safety and labour health and employee satisfaction is more than 0.05. Thus, the effect of recycling packaging materials on improving these measures is not significant. This activity strongly improves environmental performance while it only improves one measure of economic performance (cost savings) and one measure of social performance (community support). The results of the ANOVA test (Appendix J) suggest that the effects of respondents' titles on the measures of sustainable performance for this activity are not significant.

6.2.9 Overall discussion about the benefits of environmental activities

The results of this study practically confirm that environmental activities have the potential to improve the economic, environmental and social performance of a logistics company. The results also show that implementing an environmental activity may improve several measures of three dimensions of sustainable performance simultaneously (see Table 6.10). In addition, improvement in some measures can indirectly improve some latent measures. For instance, improved community support (as discussed before in the section on the use of environmentally-friendly energy sources) can provide companies with several social and economic advantages such as good image and reputation of a company, customer satisfaction and consequently increasing market share, sales volume and profitability.

Customer satisfaction is a latent measure of sustainable performance with a dyadic nature because it affects the social and economic dimensions of sustainable performance (Ahi & Searcy 2015). Similar to this measure, there are some measures which belong to two or three dimensions of sustainability with the dyadic or triadic nature which improve more than one dimension of sustainability. Community support is another example of a dyadic measure as it includes both social and economic effects (Schulz et al. 2016Ahi & Searcy 2015; Neely, Ahi & Searcy 2015). The discussion in the previous sections explained how improving community support can enhance the reputation and image of a company and consequently yield several benefits and advantages. There are some measures with a triadic nature (economic, environmental and social) such as a green image. When improving a measure of sustainable performance enhances the other latent measures with a dyadic or triadic nature, two or three dimensions of sustainable performance are improved simultaneously and improving sustainable performance can provide a company with a competitive advantage in the market (Sigalas & Pekka Economou 2013; Sigalas, Pekka Economou & Georgopoulos 2013). Therefore, the activities affecting these dyadic and triadic measures play an important role in improving sustainable performance.

Since these latent measures are intangible resources for a company (Hill & Jones 2012) and intangible resources can be sources of competitive advantage based on a resource-based view (Hill & Jones 2012), the environmental activities which directly or indirectly improve the latent and/or apparent measures of sustainable performance are sources of competitive advantage. Moreover, improving the latent measures may provide companies with a competitive advantage, although companies fail to focus carefully on latent measures (Bhat & Darzi 2016). Thus, implementing those environmental activities may act as a means of achieving a competitive advantage through improved sustainable performance.

According to Gao (2013) and Christopher (2005), different service offerings and lower costs can be sources of competitive advantage for logistics companies. The results of this research study indicate that environmental adoption in logistics services may be an opportunity for creating service differentiation and making a logistics company a leading company in the market. Furthermore, increasing in cost savings is a consequence of the implementation of environmental activities. Based on Porter's theory (1985), this study confirms that the adoption of environmental activities may facilitate the creation of a competitive advantage through differentiation and reducing costs. According to Yadav, Han and Kim (2017), environmental activities towards developing unique resources benefit companies with a competitive advantage. The results of their study empirically confirm the economic value of implementing environmental activities such as the positive effects of environmental activities on enhancing the profit margin.

The results of the t-student test showed the effects of each environmental activity implementation on improving the various measures of sustainable performance and helped this research study to have a ranking of the most influencing environmental activities to answer SRQ3 as follows:

> ***SRQ3:*** *Which environmental activities have a greater influence on improving sustainable performance for logistics companies?*

The effects of environmental activities on improving the measures of sustainable performance are illustrated in Table 6.10. Some environmental activities appear to have a greater influence on improving sustainability. These effects can be considered from several points of view.

For example, by considering all dimensions of sustainable performance or considering them from the perspective of each dimension separately to find the most and the least influential activity. By considering the effects on improving all dimensions of sustainability, optimisation of the distribution process (which is an activity related to environmentally-friendly transportation) is the most influencing activities because it improves all measures of sustainability. Replacing old vehicles with energy-efficient types as well as waste control are other activities have the third rank with improving seven measures. The use of environmental management systems is ranked second. Efficient storage of goods and the use of energy efficient refrigerants are two environmental activities to have environmental warehousing. Efficient storage of goods is ranked second along with the environmental management system while the use of energy-efficient refrigerants is the least influential environmental activity among all environmental activities because it improves none of the sustainable performance measures. Both use of environmentally-friendly energy sources and recycling packaging materials are placed at fourth rank with improving five measures.

Table 6. 10 Ranked environmental activities based on their effects on sustainability

Environmental activities in logistics (number of affected measures)	Rank	Measures of sustainable performance								
		Economic			Environmental			Social		
		Market share	Cost savings	Sales volume	Material usage	Energy consumption	Pollution control	Work safety and health	Employee satisfaction	Community support
Optimisation of the distribution process (9)	1	*	*	*	*	*	*	*	*	*
Use of environmental management system (8)	2	*	*	*	*	*	*	*		*
Efficient storage of goods (8)	2	*	*	*	*	*	*	*	*	
Replacing old vehicles (7)	3		*		*	*	*	*	*	*
Waste control (7)	3		*		*	*	*	*	*	*
Use of environmentally-friendly energy sources (5)	4		*			*	*		*	*
Recycling packaging materials (5)	4		*		*	*	*			*
Use of energy efficient refrigerants (0)	5									

Table 6.10 also shows that costs savings, energy consumption and pollution control are the sustainable performance measures with the most potential to improve by the most number of environmental activities (seven). Material usage and community support are improved by 6 environmental activities while work safety and labour health, as well as employee satisfaction, have the third rank of potential to improve among measures. Market share and sale volume are two sustainable performance measures that have the least potential for improvement by implementing environmental activities.

Although Table 6.10 shows that some of these environmental activities have the same rank, their importance may not be the same. The importance of the measures that are improved by implementing environmental activities may affect the rank of environmental activities. In addition, the priority objective of a company in terms of improving which dimension of sustainable performance can create another ranking of them. Thus, the above ranks may be changed when the objective of the company is changed. For example, from an economic point of view, the most important environmental activities are optimisation of the distribution process, the use of environmental management systems and efficient storage of goods have the same score. These activities improve economic performance in logistics companies. The most influential environmental activities from a social lens are the optimisation of the distribution process, waste control and replacing old vehicles with energy-efficient types because according to the result of this study, all measures of social performance are improved by them. Optimisation of the distribution process and replacing old vehicles with energy-efficient types, which belong to environmentally-friendly transportation, have the most influence on improving both economic and social performance. This means that improvement in environmentally-friendly transportation by implementing these activities may provide logistics companies with both economic and social competitive advantage through improving sustainable performance. Moreover, since the results showed that more than 70% of the sample companies offer freight transport and distribution services, implementing these two activities can play a vital role in reducing pollution.

From an environmental point of view, all considered environmental activities have a great influence on improving environmental performance except for the use of energy-efficient refrigerants and the use of environmentally-friendly energy sources. Although around 54% of respondents used environmentally-friendly energy sources in their companies, this activity was not found to have a lot of effect on the improvement of sustainable performance. Use of energy-efficient refrigerants is a useful activity to improve sustainable performance through reduced energy consumption and increased cost savings (Lorentz et al. 2011; Oh et al. 2016; Qyyum & Lee 2018; Welford 1999). However, this study's respondents believe that the effects of this activity on improving sustainable performance measures are not significant. These unexpected results whencompared with the literature may be due to several reasons such as not offering chill distribution services, not replacing old refrigerants with the energy-efficient types or not measuring and recognising the effect of these activities on sustainable performance measures. Therefore, this activity may not be an important and effective activity for improving performance and achieving a competitive advantage for sampled logistics companies.

Thus, environmental activities are not suggested solely to protect the environment, these activities can directly and/or indirectly improve the economic performance of logistics companies. Although the high costs of implementing environmental activities are mentioned as a barrier for environmental activity adoption (Govindan et al. 2014), practically identifying and disclosing the financial benefits of them can encourage companies to implement them. Although SRQ3 was answered as shown in Table 6.10, there are some reasons that may affect this ranking. Environmental activities with the same rank may have various levels of importance from the logistics managers' perspective because they considered that these activities improve various measures of sustainable performance with different degrees of importance from the managers' viewpoints. For example, the environmental activity that improves the sustainable performance measures, which have the most important weight, may have a higher rank to compare with other environmental activities. Therefore, considering the importance weight of each measure of sustainable performance from the logistics managers' viewpoint could be one of the appropriate methods to rank the most influencing and important environmental activities suggested by scholars (Saaty & Decision 1990; Tavana & Hatami-Marbini 2011). Pairwise comparison of three dimensions of sustainability and nine measures of sustainable performance was used to provide a more complete answer to SRQ3.

6.3 Pairwise comparison for dimensions and measures of sustainability

The most influential environmental activities which improve sustainable performance could be prioritised when the importance weight of each measure of sustainable performance is determined. In addition, the priority objective of a company plays a vital role in identifying the most influencing activity for implementation. Therefore, the pairwise comparison is an appropriate method by which to extract the importance weight of measures of sustainable performance from the logistics managers' viewpoints and could be one of the ways of ranking environmental activities in logistics. The use of the AHP method and Expert Choice software help this study to extract the importance weight of each measure of sustainable performance, which will be associated with each branch of the decision-making tree in the next sections.

This study asked the managers to do a pairwise comparison between dimensions and measures of sustainability. The pairwise comparison was conducted to determine the importance weight of nine measures by AHP because the use of pairwise comparison and AHP in the decision-making process are best illustrated in the more than 1000 references cited (Saaty & Decision 1990; Tavana & Hatami-Marbini 2011). As discussed in Chapter 4, the Saaty scale was used for pairwise comparison. Since there was a vast number of responses, the group AHP method was used. The relative importance of the attributes has been made in good faith for making judgments and then the AHP calculations led inexorably to the logical consequence of those judgments (Hatami-Marbini & Tavana 2011). Expert Choice software was used for ranking. In this regard, the average scores of all responses were set in a pairwise matrix.

6.3.1 The matrix of sustainability dimensions

Several matrices in this section compare the importance weight of each dimension of sustainability and three measures of each dimension separately based on their average scores. Table 6.11 shows the average of all importance weights in terms of the most important dimensions of sustainability from the logistics managers' viewpoints. Improvement in the economic dimension was found to be more important when compared with improvement in both environmental and social performance. In addition, the results show that logistics managers in the sample believed that improvement in environmental performance is more important than social performance. These average scores were used to determine eigenvectors through the AHP (Hatami-Marbini & Tavana 2011). The Expert Choice software extracted these eigenvectors by using the preference matrix (Appendix M).

Table 6. 11 Preference matrix of dimensions of sustainability

Preference of the row to the column	Economic	Environmental	Social
Economic		3.260	1.680
Environmental			2.770
Social			

Since AHP has an axiomatic foundation and the cardinal measurement of preferences is fully represented by the eigenvector method, the principles of hierarchical composition and rank reversal are valid (Harker & Vargas 1990). The average scores were used to determine the eigenvectors shown in Figure 6.1: the eigenvectors for the economic dimension (0.598), environmental dimension (0.230) and social dimension (0.172). Since the inconsistency rate is 0.05 (Figure 6.1) which is less than 0.1, the results of the comparison are consistent. Thus, in this sample, economic performance is the most important dimension, followed by the environmental dimension; the social dimension has the least important weight from the Australian logistics managers' viewpoints in this sample.

Economic performance is traditionally the most important because improving it may guarantee the success of a company in the market. Awareness about environmental issues and other factors influencing it such as governmental regulations and support in recent years have highlighted the importance of this issue which is understandable from the managers' viewpoints. However, the results show that the importance of the social aspect still needs to receive more attention because there is also a gap in the literature in terms of paying more attention to social performance and its measures. Figure 6.1 graphically shows the output of the software (Appendix M).

Figure 6. 1 Eigenvectors of sustainability dimensions matrix

The AHP method normalises the importance weights of the measures using Expert Choice software and reveals how much of the total weight (1.00) can be shared with each measure (Rezaei 2015). Thus, the eigenvectors show relative weights among the measures that were compared. The normalised and extracted vectors of importance in Figure 6.1 show that the economic dimension has nearly 60% of the total and sits at a considerable distance from other dimensions while the environmental performance is slightly more important than the importance of social dimension and its measures. Since humans are not always consistent, AHP allows for some small inconsistency in judgment which accounts for less than 0.1 (Rezaei 2015). The inconsistency rate of this matrix reveals that inconsistency is acceptable.

6.3.2. The economic matrix

The respondents were asked to do a pairwise comparison of the measures of economic performance and Table 6.12 shows the average of all related scores that were determined by respondents for these measures. The AHP method was used for extracting the preference or importance weight of each economic measure. Figure 6.2 shows the output from the Expert Choice software and the eigenvectors for market share, costs savings and sales volume which measure 0.435, 0.355 and 0.209 respectively. Thus, market share is the most important measure of economic performance, which is followed by cost savings as the second important measure in this dimension, and sales volume has the least importance. Figure 6.2 shows the inconsistency rate is 0.06, therefore, the results of comparison matrixes are consistent (Appendix M).

Table 6. 12 Preference matrix of economic measures

Preference of the row to the column	Market share	Costs saving	Sales volume
Market share		1.580	2.190
Costs saving			1.610
Sales volume			

Since the economic dimension is the most important to improve from the logistics managers' viewpoints and market share among this dimension has the highest importance, those environmental activities that improve market share have more importance. The eigenvectors help this study to identify what environmental activities are most important, which will be explained in the rest of the chapter.

Figure 6.2 Eigenvectors of the economic performance matrix

6.3.3. The environmental matrix

Table 6.13 shows the average scores of each measure of environmental performance and Figure 6.3 shows that the related eigenvectors for energy consumption, material usage and pollution control are 0.397, 0.395 and 0.208 respectively. Energy consumption has the most important weight, which is followed by material usage in second place. Pollution control has the least important weight (Appendix M). The results of the comparisons are consistent because the inconsistency rate is less than 0.1 (Figure 6.3).

Table 6. 13 Preference matrix of environmental measures

Preference of the row to the column	Material usage	Energy consumption	Pollution control
Material usage		1.070	1.760
Energy consumption			2.050
Pollution control			

Figure 6. 3 Eigenvectors of the environmental performance matrix

6.3.4. The social matrix

Table 6.14 shows the average of all responses and Figure 6.4 shows that the eigenvectors of work safety and labour health, employee satisfaction and community support are 0.642, 0.239 and 0.118 respectively. Therefore, work safety and labour health has the most important weight and is positioned at a large distance from the other social measures. This shows that logistics managers care about the safety and health of their employees which has received attention in Australia. Community support has the least important weight and employee satisfaction is in second place. Thus, employee satisfaction has preference for improvement to compare with community support from managers' view.

Table 6. 14 Preference matrix of social measures

Preference of the row to the column	Work safety and labour health	Employee satisfaction	Community support
Work safety and labour health		3.820	3.850
Employee satisfaction			2.890
Community support			

Figure 6.4 shows the inconsistency rate is approximately equal to 0.1, therefore, the results of comparisons are consistent (Appendix M). Since all inconsistency rates are less than 0.1, all comparisons are consistent. Thus, this study has used eigenvectors as the importance weight of each measure of sustainable performance to rank the environmental activities in logistics.

Figure 6.4 Eigenvectors of the social performance matrix

6.4 Prioritising environmental activities

Figure 6.5 shows the decision-making tree to find environmental activities with greater influence on improving sustainable performance that may achieve a competitive advantage in the context of sustainability. The importance weight of each dimension and measure is shown to find the most and the least influencing environmental activities to improve sustainable performance, and it is necessary to multiply the weight of affected measure to the weight of each dimension for each effective path from activity to the measure. This method is used to prioritise environmental activities based on their effects on improving sustainable performance by considering the importance weight of dimensions and measures of sustainable performance from the logistics managers' viewpoint.

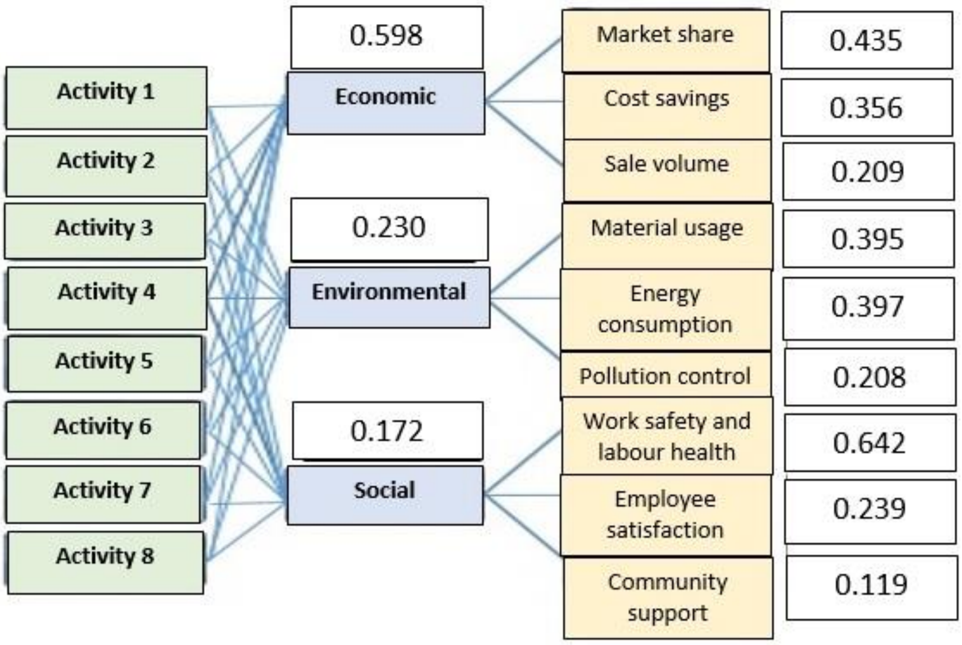

Figure 6.5 Decision-making tree for environmental activities

The following formula can determine the importance weight for each environmental activity:

$$A.w_i = \sum_{i=1}^{i=8} Dw_i \times Mw_i$$

Awi : Importance weight of each environmental activity

Dwi : Importance weight of each dimension of sustainability

Mwi : Importance weight of each measure of sustainable performance

This formula is used for eight environmental activities, but to prevent repetition, only the calculation of one activity is shown as follows:

Example activity: optimisation of the distribution process

Weight A1: (0.598). (0.435+0.356+0.209) + (0.230). (0.395+0.397+0.208) + (0.172). (0.643+0.239+0.119) = 1.000

Since optimisation of the distribution process affects all considered measures of sustainable performance, it achieved a complete score (1 out of 1) and is set in rank 1. Although some activities such as the use of environmental management systems and efficient storage of goods have the same rank in Table 6.10, their scores and ranks are changed in Table 6.15 because pairwise comparison has extracted their importance and preference weight from the logistics managers' viewpoints. According to the above formula, the final weight and rank of each environmental activity depend on improving sustainable performance as follows in Table 6.10.

Table 6.15 shows the top three most important environmental activities with the greatest influence on improving all dimensions of sustainability are optimisation of the distribution process, efficient storage of goods and use of environmental management systems respectively. Conversely, the use of environmentally-friendly energy sources is an environmental activity with the least importance from the managers' viewpoints and the use of energy-efficient refrigerant is not important due to the lack of influence on improving sustainability.

Table 6.15 Scored and ranked activities based on AHP result

Environmental activity	Importance weight	Rank
Optimisation of the distribution process	1	1
Efficient storage of goods	0.979	2
Use of environmental management systems	0.959	3
Replacing old vehicles with energy-efficient types	0.615	4
Waste control	0.594	5
Recycling packaging materials	0.462	6
Use of environmentally-friendly energy sources	0.412	7
Use of energy-efficient refrigerants	0	8

These ranks can be changed when the environmental activities are considered from each dimension of sustainability (economic, environmental or social) viewed separately or from both or three dimensions of sustainability simultaneously. For instance, a company can identify the most effective environmental activity to improve economic and social measures of sustainable performance and it can be dependent on the company's improvement objectives. Depending on company objectives, there are several rankings of environmental activities which are concluded and shown in Table 6.16.

For example, by considering the effects of environmental activities merely on the economic dimension, three activities have the same weight and rank. From an environmental point of view, the activities can be separately ranked. These environmental activities influence almost all measures of environmental dimensions except for the use of energy-efficient refrigerants. The results of this study showed that the use of environmental refrigerants has no significant effect on improving environmental measures as well as no significant effect on improving economic and social measures of sustainable performance for sampled companies. Although academic literature points to this activity as an effective activity to improve environmental performance (Lorentz et al. 2011; Welford 1999), the managers did not perceive this environmental activity with significant effects on improving sustainable performance. The possible reasons for these unexpected results vary. Firstly, the sample may not offer chill distribution services. Secondly, their old refrigerants may not be replaced with the energy-efficient types or the sample may not have measured the reduced energy consumption and costs savings. They also may not aware of the effects of this activity on improving measures. The results of this study suggest that the use of environmentally-friendly energy sources is another activity which is weaker than others to improve environmental performance in the sampled because the sample believed that it has no effect on material usage. According to literature, this activity can improve pollution control and energy consumption as well as material usage because, for example, using LED lighting has a longer life cycle, thus, the use of raw material for manufacturing them will decrease. Using natural skylight windows, fluorescent lighting, solar systems are other examples that also decrease material usage such as fuel, wood and energy such as gas when improve energy consumption and pollution control. However, the possible reasons may be that the sample do not investigate the effects of environmentally-friendly energy sources on material usage and they are not aware of this impact. Another possible reason may be relevant to the size of warehouse, office or distribution centre that they use these energy sources. The impact of using environmentally-friendly energy sources on improving material usage may be significant in larger scale. Moreover, this effect may be various from industry to industry. For instance, it may be different among manufacturing and service sectors.

By considering the effects of each activity on improving environmental performance as well as the importance weight of the environmental performance measures from the managers' view point, Table 6.16 shows the ranking of environmental activities from an environmental view. Other rankings (columns) in this table are based on the measure importance and performance improvement from other views to sustainability including economic, social, economic and environmental, economic and social, social and environmental, as well as economic, environmental and social simultaneously.

The social view reveals another rank of environmental activities. According to Table 6.16, optimisation of the distribution process and replacing old vehicles with energy-efficient types have the first rank and, according to the academic literature (Zhang et al. 2014; El-Berishy & Pannek 2017; Lam & Dai 2015), these two activities belong to environmentally-friendly transportation. Waste control and efficient storage of goods have the second rank. The least important activities from a social view are the use of energy-efficient refrigerants and recycling packaging material.

Ranking can also be conducted by considering two dimensions of sustainability simultaneously. For instance, Table 6.16 shows ranked activities from the mixed view of economic and environmental dimensions, economic and social as well as environmental and social dimensions. The results of ranking from several views concluded in Table 6.16 to have an overall look at the environmental activities in logistics and improving dimensions of sustainability and showing that companies can improve their sustainable performance by implementing environmental activities, depending on the company’s objectives. For example, when a company looks purely at the improvement in its social performance, implementing the first and second social ranked activities can help it to achieve this. Therefore, the results of this study addressed and answered the PRQ of this study and suggested that environmental activity adoption can improve the sustainable performance measures which may provide a company with a competitive advantage and the effect of each activity on improving sustainable performance measures are different.

There are some activities that improve the same measures and Table 6.16 shows that they have the same rank from a specific view. However, this table does not show to what extent each environmental activity can improve these measures because measuring these effects is not in the area of current research. In addition, measuring some effects needs various measures and metrics which are the gaps of the literature. Therefore, the amount of improvement could be measured in future research. The lack of appropriate metrics by which they can be measured, especially in environmental and social dimensions, is the main issue. Although this study helps to compare the environmental activities in logistics to find the most and the least influential activities for improving sustainable performance, there is a need to consider the effects of implementing these activities in the long term and determining the amount of improvement in each measure.

Table 6. 16 Weighted and ranked environmental activities from several views to sustainability

Viewpoints / Environmental activities	Economic		Environmental		Social		Economic & environmental		Economic & social		Environmental & social		Economic, environmental & social	
	Weight	Rank	Weight	Rank	Weight	Rank	Weight	Rank	Weight	Rank	Weight	Rank	Weight	Rank
Optimisation of the distribution process	0.598	1	0.230	1	0.172	1	0.828	1	0.770	1	0.402	1	1	1
Use of environmental management systems	0.598	1	0.230	1	0.131	3	0.828	1	0.729	3	0.361	3	0.959	3
Efficient storage of goods	0.598	1	0.230	1	0.151	2	0.828	1	0.749	2	0.381	2	0.979	2
Replacing old vehicles with energy-efficient types	0.213	2	0.230	1	0.172	1	0.443	2	0.358	5	0.402	1	0.615	4
Waste control	0.213	2	0.230	1	0.151	2	0.443	2	0.364	4	0.381	2	0.594	5
Use of environmentally-friendly energy sources	0.213	2	0.139	2	0.061	4	0.352	3	0.274	6	0.20	5	0.412	7
Recycling packaging materials	0.213	2	0.230	1	0.020	5	0.443	2	0.233	7	0.25	4	0.462	6
Use of energy-efficient refrigerants	0	3	0	3	0	6	0	4	0	8	0	6	0	8

6.4.1. Comparing measures of sustainable performance from two views

The measures of sustainable performance could be ranked from two views. Firstly, they can be ranked based on the number of environmental activities improving them and secondly, they could be ranked by normalising their importance weight from AHP. The total importance weight of three dimensions of sustainability was considered one and the total importance weight of nine measures which belonged to the three dimensions of sustainability is one (shown in Figure 6.5). The normalised importance weight of each measure (of nine measures of sustainable performance) could be defined as a fraction of the total importance weight (1) when its importance weight is calculated among nine measures. Thus, the normalised weight (the importance weight of each measure out of 1) for each measure was calculated by multiply the importance weight of each measure to the importance weight of its dimension (Figure 6.5) and the normalised importance weight are represented in Table 6.17. The nine measures of sustainable performance were ranked in the rank column of Table 6.17, according to their normalised weight, when these nine measures were compared all together. Another column of Table 6.17 shows that how many environmental activities can improve each measure.

Both Table 6.16 and 6.17 provide logistics managers with useful information when they want to develop their strategies in terms of implementing each environmental activity and improving each measure of sustainable performance based on company's objectives and preferred measure to improve by considering the importance weight of each measure and the effects of each environmental activity on improving the most important measures of sustainable performance.

Table 6. 17 Weighted and ranked measures of sustainable performance

Measures of sustainable performance	Normalised importance weight	Rank	The number of environmental activities improving them
Market share	0.260	1	3
Cost savings	0.213	2	7
Sales volume	0.125	3	3
Energy consumption	0.092	5	7
Material usage	0.091	6	6
Pollution control	0.048	7	7
Work safety and labour health	0.110	4	5
Employee satisfaction	0.041	8	5
Community support	0.020	9	6

The highest rank measures (1 to 3) are measures of economic performance and cost savings among them has the most potential to improve by seven out of eight environmental activities. Although market share and sales volume have the first and the third ranks, the number of environmental activities improving them are not many. The fourth rank is for work safety and labour health which is a measure of social performance and five out of eight environmental activities improve it. Therefore, work safety and labour health, as well as all measures of economic performance, may have priority to improve. Energy consumption to compare with material usage showed slightly more importance weight from logistics managers' view and it could be improved by seven environmental activities. Pollution control, employee satisfaction and community support have the weakest importance weight and the least number of environmental activities improve pollution control and employee satisfaction.

6.5 The viewpoints of 1PLs to 5PLs about environmental activities

Logistics managers were asked to evaluate the effects of implementing environmental activities on improving the measures of sustainable performance. In addition, they were asked to indicate the types of logistics services that are offered by their companies. The means of the measures of sustainable performance were compared together based on the number and different logistics services which are offered by companies to investigate the effect of the level of logistics companies (1PLs to 5PLs) on the means of the measures. The results showed that all the measures of sustainable performance that are affected by the use of environmental management system have very close means (around 3.5) and only market share and community support have slightly higher means than others. It appears that there is not a big difference between the opinions of logistics companies with different services although 1PLs believed that this environmental activity had increased sales volume as well as market share. In addition, those companies that offer consultancy within supply chains and networks (4PLs and 5PLs) believed that the effects of environmental management systems on material usage and energy consumption are higher than other measures.

All types of logistics companies claimed that waste management improves material usage and cost savings more than other measures, with a considerable difference between means of measures. Similarly, all companies with a different level of service offering believed that the use of energy-efficient refrigerant has the most effect on improving cost savings compared with other measures, although the results of the t-test do not show the significant effect of this activity on improving cost savings. The logistics companies that offer only freight forwarding stated that cost savings and community support are those measures that improve more than others using environmentally-friendly energy sources. However, others, including 3PLs, 4PLs and 5PLs, believed that the effects of this activity on pollution control are also higher than other measures.

In terms of recycling packaging material, all types of logistics companies mentioned that material usage and pollution control are improved more than other measures. Except for 1PLs, companies from several levels believed that this activity improves cost savings as well as those two measures. The companies that only offer freight transport believed that replacing old vehicles with energy-efficient types improves cost savings, employee satisfaction and community support more than other measures. Other companies with a wider range of services confirmed that this activity considerably improves cost savings more than other measures and community support, employee satisfaction, pollution control and energy consumption are other measures which improved more than other measures and less than costs savings.

All companies believed that optimisation of the distribution process has the most effect on improving costs savings and energy consumption. Work safety and labour health, as well as employee satisfaction, have higher means after these two measures, although 1PLs and 2PLs which only offer freight transport and distribution services did not give them high (the mean score between 3 to 4 out of 5) scores. Although there were some common opinions in terms of the relationship between implementing an activity and improving a measure of sustainable performance, there are some differences in the number of effects or improvement. Moreover, as discussed before, the importance of measures from the managers' viewpoints is different. These differences can be relevant to several factors such as the financial strength of companies, type of logistics companies and the insight of managers. For example, the companies offering a wider range of logistics services care more about employee satisfaction and pollution control as well as work safety and labour health.

6.6 Summary

This chapter presented the quantitative data analysis and discussed the qualitative and quantitative outcomes to answer the research questions. Firstly, a t-student test was used to investigate the effects of implementing environmental activities on improving sustainable performance and answer the PRQ. The results showed that the optimisation of the distribution process, use of environmental management systems, efficient storage of goods and replacing old vehicles with energy-efficient types are the most influencing environmental activities to improve sustainable performance. Secondly, since some activities had the same ranks, the analytical hierarchy process (AHP) method was used to prioritise the environmental activities based on the importance weight of sustainable performance measures from the managers' viewpoint. In this regard, a pairwise comparison was conducted to extract the importance weight of each measure and dimension of sustainable performance. The results of the pairwise comparison show that economic dimension is the most important dimension of sustainability from the logistics managers' viewpoint and market share, energy consumption and work safety and labour health have the most importance weight among their groups. The importance weight of measures and dimensions were used to rank the most important environmental activities from several viewpoints including economic, social and environmental (Table 6.16). Optimisation of the distribution process has the first rank from several points of view. This chapter suggests that environmental activities have the potential to improve sustainable performance for logistics companies, although their potential are different. Thus, the contributions of this chapter are:

- Empirically investigating the effects of implementing eight environmental activities on improving nine measures of sustainable performance as well as identifying the most and the least influencing environmental activities in the sampled companies.
- Discussion on the benefits of implementing environmental activities and the effects of improving measures on enhancing other measures of sustainable performance
- Identifying the importance weight of each measure and dimension of sustainable performance from logistics managers' view as well as ranking these measures and dimensions
- Identifying the importance weight of eight environmental activities in the Australian logistics based on sustainable performance measures.
- Prioritising eight environmental activities from seven views including sustainable, economic, environmental, social, both economic and environmental, both economic and social as well as both environmental and social views.
- Comparing the importance of sustainable performance measures from two views.
- Discussion on the viewpoints of 1PLs to 5PLs about environmental activity adoption.

CHAPTER SEVEN: CONCLUSION

7.1 Introduction

This thesis is an empirical study investigating the effects of implementing environmental activities on sustainable performance for Australian logistics companies. This study required an extensive literature review in the field of performance improvement and environmental activities, in the context of the logistics industry (in Chapters 2 and 3 respectively). In addition, based on the literature review, a conceptual framework was developed. Based on the conceptual framework, a survey instrument (questionnaire) on the Survey Monkey website was prepared to answer the research questions. The study conducted a web-based survey as a quantitative method for collecting data from Australian logistics managers through random sampling to answer the following four research questions:

PRQ: *Does adoption of environmental activities improve sustainable performance for logistics companies?*

> ***SRQ1:*** *Which factors have a greater influence on logistics companies toward adopting environmental activities?*
>
> ***SRQ2:*** *Which environmental activities have been undertaken by Australian logistics companies in the last five years?*
>
> ***SRQ3:*** *Which environmental activities have a greater influence on improving sustainable performance for logistics companies?*

The web-based survey in the quantitative phase of the study explored the relationship between implementing environmental activities and improving sustainable performance to answer the PRQ. In addition, the questionnaire asked respondents to score and rank factors influencing environmental activity adoption to answer SRQ1. As discussed in Chapter 5, this part of the conceptual framework was investigated using EFA and Friedman tests. To answer SRQ2, the most implemented environmental activities by Australian logistics companies in the last five years were investigated. Respondents were asked to indicate the environmentally-focused activities in logistics that their company implemented in the last five years. To answer SRQ3, the measures of sustainable performance were ranked by the AHP method, as described in Chapter 6. Finally, the environmental activities were ranked based on their effects on improving the measures of sustainable performance as well as the importance weight of these measures by using t-student tests and combining the results of these tests and the AHP results. Since sample frame and non-response bias are the most commonly cited issues of web-based surveys (Fleming & Bowden 2009), this study used random sampling for preventing the research from sample bias and used non-response bias test to avoid non-response bias explained in Chapter 5. Since Random sampling is the most appropriate form of probability sampling and generalisation is gained through statistical probability (Easterby-Smith, Thorpe & Jackson 2012), an equal chance of being selected by each member of the population is the advantage of this sampling strategy. Therefore, an appropriate strategy can be random sampling to decrease bias (Sen & Singer 2017) when it is often difficult or impossible to identify every member of the large population such as this study which is collecting data from Australian logistics companies from all Australian States. Since the access to all members of this large population was challenging, time and cost consuming, the random sampling was used and since the target population of this research was finite, the table developed by Krejcie and Morgan (1970) was used to determine the sample size. Then, the sample members were chosen by first, generating a table including all logistics companies from provided database as numbered population and then, selecting a starting point on the random number table as well as using a direction of five added number. In terms of assessing the non-response bias, the completed responses were divided into two early and late groups and no significant difference were found between these groups. This chapter summarises the research findings from a review of the literature and the empirical study perspectives with a discussion on the contributions of this study. The limitations of the research are discussed, and further research directions are recommended.

7.2 Summary of findings

Findings from the literature review theoretically synthesised various views about performance and competitive advantage and justified that improving sustainable performance may be a means of achieving a competitive advantage. In this regard, the most appropriate measures of sustainable performance were found and used from the literature which were tested empirically, and those that are suitable for the logistics industry were identified. In addition, the most relevant influencing factors for environmental adoption and the most suitable environmental activities in logistics were synthesised and analysed from the literature to develop a conceptual framework. Findings from the literature and the conceptual framework were examined empirically, and this is explained in section 7.2.2 with regard to empirical findings.

7.2.1 Findings from the literature review

This research synthesised the views on achieving a competitive advantage and the relationship between competitive advantage and performance in the literature. This thesis found that although there are several views regarding competitiveness, which in turn introduce various means of achieving a competitive advantage, improving performance to achieve a competitive advantage is a common path identified by researchers. Recently, sustainability has became an important factor affecting the global market and improving sustainable performance can be a means of achieving a competitive advantage.

Chapter 2 consisted of a literature review on competitiveness, competitive advantage and performance and described how this study synthesised several definitions and views about competitiveness and found that a competitive advantage is directly or indirectly achievable by improving performance where most the views concerning competitive advantage are still relevant to performance.

Environmental adoption as a dimension of sustainability is one of the factors affecting the modern market and business environment. According to DCV, companies can adopt environmental activities in their business to cope with the new business environment. Reconfiguring the business activities, internal and external competencies and resources with an environmentally-friendly orientation may help companies achieve a competitive advantage. The necessity of considering sustainable performance (including economic, environmental and social performance) instead of economic performance and implementing environmental activities in the modern market is also justified by DCV and MBV. The potential of investments in the three dimensions of sustainability to create a competitive advantage in the current market can be justified by MBV, DCV, CBV and transient advantage view.

A competitive advantage in the context of sustainability can stem from superior sustainable performance by improving its measures (Sigalas & Pekka Economou 2013; Sigalas, Pekka Economou & Georgopoulos 2013) because highly competitive markets will likely require more than economic outcomes to develop a competitive advantage (Schulz et al. 2016). Since strategies with social and environmental dimensions will become increasingly significant in developing a competitive strategy in the market with sustainability orientation (Schulz et al. 2016), evaluation of sustainable performance as a means of creating a competitive advantage needs a holistic approach and an appropriate tool for considering all dimensions of sustainability.

The current study is one of the recent that consider competitive advantage in the context of sustainability. Achieving competitive advantage through improving performance is considered in the conceptual framework of this study as an output of the model which stems from the sustainable performance of a company and can act as an influencing factor (an input of the model) for environmental adoption based on the above discussion. This feedback vector of the model was investigated empirically as well as other components of the conceptual framework which have not been previously explored from a logistics perspective. Since sustainable performance is defined based on the triple-bottom-line, the most appropriate measures in the economic dimension, environmental dimension and social dimension were considered in this study as being more suitable for the logistics industry. In addition, the most appropriate and relevant environmental activities in logistics (eight activities) based on their main services were chosen from the literature and discussed in Chapter 3.

The factors influencing environmental adoption (12 factors) were explained in Chapter 3. Although the components of the conceptual framework were collected from the literature and several case studies worldwide, the conceptual framework was examined in Australian logistics companies to achieve the empirical findings. The conceptual framework for the current study has been developed for the first time in the logistics industry which bridges the literature on performance and competitive advantage with the literature on environmental adoption and sustainability.

7.2.2 Findings from the empirical study

This section summarises the empirical results generated from a web-based survey undertaken in the phase of data collection of this study. A web-based survey was conducted to collect data from 297 logistics companies as a random sample of study from the seven states of Australia. A table was created including all logistics companies from seven States of Australia and according to the several databases indicated in Chapter 4. Then, each member of the population was numbered in the table. After selecting a starting point on the random number table, a direction of five added number was used to select the sample. The response rate was 21% in this study. This section begins by addressing SRQ1.

> ***SRQ1:*** *Which factors have a greater influence on logistics companies toward adopting environmental activities?*

The results of the EFA in the current study showed that the most identified factors in the literature belong to three main components. In addition, the Friedman test was done to rank the most influencing factors and showed the most and the least influencing factors toward environmental activity adoption from the sample of this study. The results of the EFA and Friedman tests confirmed that the potential for achieving a competitive advantage is one of the strongest factors influencing environmental adoption. Hence, implementing environmentally focused activity can improve sustainable performance due to having positive effects on measures of sustainability which may provide a company with a competitive advantage.

A feedback vector was included in the conceptual framework of this study, which shows that achieving a competitive advantage may stem from an improving measure of sustainable performance, can act as an influencing factor towards the adoption of environmental activities. The empirical results of this study not only confirm that improving sustainable performance can act as a means of achieving a competitive advantage, but also confirm that this factor is one of the most influential towards environmental adoption (the feedback vector of the conceptual framework) which has not been previously investigated empirically.

To find other influencing factors toward environmental adoption, which may not have been indicated in the literature, an open-ended question asked respondents to state other factors that motivate them for environmental adoption such as willingness to be a market leader and high responsibility which could be empirically investigated in future research. This study also investigated that various logistics actors (1PLs to 5PLs) may be motivated by different influencing factors toward environmental adoption. The results showed that some influencing factors may have more effects on some logistics actors for environmental adoption. Some influencing factors such as governmental regulation are primary influencing factors toward environmental activity adoption for all types of logistics companies in the sample. However, when the capability and business level of a company's activities are increasing, the company offers environmental services to satisfy aware customers, being a leader in the market and achieving a competitive advantage.

Identifying the level of environmental adoption and interpreting the collected data is a gap in the literature (Lam & Dai 2015; Schaltegger et al. 2014). This study also investigated the most common undertaken environmental activities by Australian logistics companies in the last five years to answer SRQ2 as follows:

> ***SRQ2:*** *Which environmental activities have been undertaken by Australian logistics companies in the last five years?*

Investigating the level of environmental adoption in Australian logistics showed that some environmental activities have been implemented by more than 70% of the sample of this study. This suggests that logistics companies that have not implemented this environmental activity are lagging behind other companies in this industry. Other activities have been implemented by around 30% of Australian logistics companies in the sample of this study, have the potential to create a competitive advantage for leading companies. Therefore, implementing the effective environmental activities for improving sustainable performance, which has the least percentage of implementation in the sample of this study, may show the opportunities for those companies who attempt to be market leaders. To find other undertaken environmental activities which may not have been indicated in the literature, an open-ended question asked respondents to state other environmental activities implemented by logistics companies. The results extend the environmental adoption and can be empirically investigated in future research.

Since there are different views to implementing environmental activities that consider them as benefits or costs, this study investigates the effects of implementing environmental activities on improving sustainable performance which may provide companies with benefits. This study identified eight environmental activities in logistics and nine measures of sustainable performance to investigate the relationship between them. Although some research has recently been conducted in terms of sustainability, according to the literature, the number of empirical studies that were conducted in the service sector are few. This research is one of the recent empirical research studies that investigates the effects of environmental adoption on improving sustainable performance and the first research that investigates it in Australian logistics companies to answer SRQ3 as follows.

> ***SRQ3:*** *Which environmental activities have a greater influence on improving sustainable performance for logistics companies?*

This study, first investigated the effects of implementing environmental activities on improving various measures of sustainable performance to find which measures could be improved by specific environmental activities. Then, this study investigated the most influencing environmental activity which can improve the measures of sustainable performance.

The findings show that implementing environmental activities in logistics not only reduces damages to the environment but also can improve the sustainable (economic, environmental and social) performance of companies. The results of this study showed that these activities have the most effects on improving environmental performance, economic performance and social performance of the sampled companies respectively. The significant effect of these environmental activities on improving sustainable performance varies. Some of the activities are more effective because they improve more measures of sustainable performance of the sampled companies. Therefore, activities have various levels of importance depending on which dimensions of sustainable performance are improved and how many of its measures with considering the importance weight of dimensions and measures.

Since some activities show that they improve the same number of various measures of sustainable performance, this study identified another appropriate method to investigate the most and the least important environmental activities from logistics managers' views. Firstly, the number of improved measures were used to rank the environmental activities. Then, the importance weight of each measure of sustainable performance from managers' views (through AHP method) were used to provide a more accurate rank of the most important environmental activities. The results showed that some measures of sustainable performance may have priority for improvement from managers' views. Therefore, understanding the importance or preference weight of the sustainable performance measures for improvement provides a ranking among the measures of sustainable performance based on their importance to managers.

Although the AHP method has been used by several scholars, this method was used for the first time in this context to rank sustainable performance measures. The AHP method was also used in the current study to prioritise the environmentally focused activities in logistics based on their effects on improving the measures of sustainable performance from the perspective of Australian logistics managers which has not been previously explored. The result of AHP in the current study provides information about which environmental activity may be preferred to be implemented by managers to improve the most important measures. In addition, pairwise comparison among measures in each dimension of sustainability showed their order of importance in that dimension. Thus, implementing those environmental activities with the most effect on improving the most important measures of sustainable performance may have more importance from logistics managers' viewpoints.

As shown in Table 6.15, the environmental activities were ranked from seven views including sustainable, economic, environmental, social, economic-environmental, economic-social and economic-environmental. These ranks show the most effective environmental activities for improving measures of sustainable performance from each and all mentioned views. Moreover, this study identified which measures of sustainable performance were affected by implementing environmental activities. In addition, the improving effects of these activities differ among several measures of sustainable performance. This study also found which measures of sustainable performance were more improved by which environmental activities.

Finally, the current study uses the findings to answer the following PRQ:

PRQ: *Does adoption of environmental activities improve sustainable performance for logistics companies?*

The findings show that although implementing environmental activities in logistics companies are designed to protect the environment from more deterioration, these activities have the potential to enhance the sustainable (economic, environmental and social) performance of companies. The significant effect of these environmental activities on improving sustainable performance varies but implemeting these environmental activities may provide a company with economic advantages which may stem from improved sustainable performance.

7.3 Contributions of the study

This study makes both theoretical and empirical contributions. Firstly, from a theoretical view, this study contributes to the literature by analysing the relationship between performance and several views of competitive advantage. The findings from the literature showed that the fundamental essence of competitive advantage emphasises the significance of improved performance. Although there are several views with regard to achieving a competitive advantage, improving performance is a common path for most views. This study is one of the few recent research studies that theoretically and empirically investigates the relationship between performance and competitive advantage from a sustainability context with a focus on the logistics industry. Therefore, the necessity of improving sustainable performance to create a competitive advantage in the modern market is justified in the conceptual framework of this study which has not been previously explored. The feedback vector of the conceptual framework of this study investigated the effects of achieving competitive advantage (through improving sustainable performance) on environmental adoption which has not been previously explored specifically in this context. According to the literature, improving performance is a means of achieving a competitive advantage. This factor was considered as influencing environmental adoption (a feedback vector of the conceptual framework) and was tested to confirm that achieving a competitive advantage is one of the most important factors influencing the sample of this study to adopt environmental activities. The conceptual framework of this study can be generalised for use in logistics research in other countries.

Secondly, this study developed a conceptual framework for investigating the most important influencing factors of environmental adoption for Australian logistics companies as well as investigating the effects of implementing environmental activities on improving sustainable performance. The literature theoretically claims that companies can adopt environmental activities to improve their performance and the empirical findings of this research suggests a theoretical link exists between implementing environmental activities and sustainable performance. Consequently, this study combines two broad subjects, namely performance and sustainability, to provide a more comprehensive picture of the relationship between environmental adoption and business benefits, thereby contributing to the literature. It confirms that adopting environmental activities in logistics can provide companies with a competitive advantage. Other researchers frequently investigated the effects of environmental adoption merely on economic performance and outcomes of a company while this study investigated these effects on the outcomes among the three dimensions of sustainable performance. This study, then, extended the literature on competitive advantage and performance in the context of sustainability.

Moreover, this study highlighted the importance of environmental activities being adopted by logistics companies to fill the gap in the literature in terms of little research undertaken in the service sector and more specifically, logistics services. Most of the researchers on environmental issues focus on the manufacturing sector. Although logistics service providers have more awareness about environmental issues, the development of the literature in this area is in its infancy. Therefore, the most appropriate environmentally focused activities for logistics companies have been synthesised and used from the literature as well as nine measures of sustainable performance that are more suitable for the logistics industry to form the conceptual framework.

A research gap was found in the literature in terms of finding ways of improving the level of environmental adoption. This study empirically showed the positive relationship between implementing environmental activities and improving sustainable performance which can act as a means of achieving a competitive advantage. The potential for achieving a competitive advantage was tested as an influential factor in environmental adoption. This study empirically showed that implementing environmental activities leads to superior performance for creating a competitive advantage which can, in turn, affect companies for more environmental adoption. This study extends the literature and covers this gap by identifying a way to increase environmental adoption which has not been previously explored in this context. When a company understands that environmental adoption is not merely beneficial for the environment but also can bring economic benefits to the company, the willingness to adopt environmental activities may increase. It can be the solution that the government wants.

Thirdly, this study contributes to the literature of influencing factors on environmental adoption. It presents some new influencing factors such as willingness to be the market leader, responsibility, risk mitigation and financial support, trade schemes for the global market, accessibility of fuel efficiency and interest of company's owner in implementing environmental activities. These factors, as well as some new environmental activities, extend the literature on environmental adoption. In addition, these new influencing factors and environmental adoption can help companies to develop their strategies as well as policy makers and regulators to establish new regulations and policies to increase sustainable development through environmental adoption.

Fourthly, another contribution of the current study is combining the AHP method and t-test in this context for prioritising environmental activities in logistics as well as ranking the measures of sustainable performance. This combination represents a useful method by which to rank environmental activities based on both their effects on improving measures of sustainable performance and the importance weight of each measure to improve. This is one of the first studies that quantifies the weight of the measures of sustainable performance and environmental activities in logistics.

The prioritising of environmental activities was conducted for the first time from seven views including economic, environmental, social, economic-environmental, economic-social, environmental-social and sustainable, as shown in Table 6.15. This method, which has not been previously presented and explored, represents a way to implement environmentally focused activities in logistics, depending on the company's objective. This method extends the literature by identifying the effects of each environmental activity in logistics on improving each dimension and measure of sustainable performance. The most and the least influential environmental activities in logistics were recognised.

The most and the least measures of sustainable performance in logistics companies affected by implementing eight environmental activities were identified. Finally, the nine measures of sustainable performance were compared together from two views. Firstly, by considering their normalised weight among nine measures provided by AHP, and secondly, by considering the number of environmental activities improving them, which have not been previously presented and explored.

From the managerial view, the results of this study provide Australian logistics managers with a list of ranked environmental activities in order of the most economic, social and sustainable as well as other views that will assist managers in deciding which activities may be the most appropriate to implement. The quantified measures of sustainable performance and environmental activities facilitate managerial decision making regarding sustainability in their business. Moreover, managers can find what improvement from each measure of sustainable performance can be achieved by implementing which environmental activities.

Public policy makers can also use the results of this study to support sustainable development that provides advantages for industries and the environment. Policy makers can find the relationship between the empirical results of this study and policy formulation to facilitate the environmental activity implementation for logistics companies. Their formulated strategies based on the empirical results may have potential to improve the level of environmental adoption and sustainability development in the logistics industry, other dependent industries, supply chains and networks.

Moreover, identifying the level of environmental adoption was indicated as a gap in the literature. This study found the level of implementing environmental activities in the sample. This study found the most and the least implemented environmental activities in Australian logistics which can help managers to benchmark their business in Australia. The managers will be able to understand how they can successfully compete beyond their rivals in the market and which environmental activities can make them different from others. It also contributes to assisting policymakers and regulators to revise the policies, procedures and regulations in terms of environmental adoption.

Ranking the measures of sustainable performance from two views as well as ranking environmental activities from seven views provide logistics managers with the required information in terms of determining and opting effective environmental activities to implement based on companies' objective for improvement. Moreover, managers can use the ranked measures of sustainable performance and ranked activities when they develop strategies, set key performance indexes and manage various teams to achieve goals.

7.4 Limitations of the study

Every research has its weaknesses. This study also had several limitations related to research strategies, time and quality. Firstly, this study only considered the most appropriate measures of sustainable performance as well as the most highlighted environmental activities in the literature because considering all indicated environmental activities and sustainable performance measures made the questionnaire too long. A long questionnaire has a high risk of respondents withdrawing early from the survey resulting in a lower response rate. Therefore, it demanded more work on other sustainable performance measures and environmental activities.

Secondly, this study used a ranking question which attempted to compare and rank influencing factors with each other simultaneously. Some activities such as pre-testing, using appropriate words with explanation about considering 12 as the most influential factor, were undertaken to clarify Question 32 and to help the respondents with having better understanding of this question. However, some of the respondents withdrew from this question and some others were confused and failed to answer correctly.

Thirdly, although the use of face-to-face interviews to collect indepth data could increase the richness of findings, collecting data in person from the sample of this study Australia would have been expensive and time-consuming. Moreover, since senior managers are busy, collecting data from them is time-consuming. Consequently, the main challenge was the lack of time of senior managers were able to contribute to participating in the survey. However, sending invitation emails and follow-up reminders on specific days and at particular times helped to increase the response rate. Finally, although qualitative questions provide the survey with more insight, the length of the questionnaire and insufficient willingness of respondents to answer open-ended questions due to they being time-poor was the reason for using a limited number of qualitative questions in this study. Although the results of this study with a 21%

response rate cannot be generalised, the conceptual framework and the survey instrument of this study can be used in several types of international logistics research.

7.5 Directions for future research

Several directions are suggested for future research. Firstly, some new influencing factors for environmental adoption such as risk mitigation and being the market leader as well as some new environmental activities such as the use of reflective paint on the warehouse walls were found in this research and these are worthy of investigating and ranking in future research. Secondly, future research can investigate more influencing factors, environmental activities as well as more measures of sustainable performance by using the conceptual framework of this study. Future research could evaluate the relationship between environmental adoption and achieving sustainable performance within a supply chain or network. Thus, future research can identify and add additional environmental activities and measures of sustainable performance to improve this conceptual framework. Considering more measures in each or all dimensions of sustainable performance can indicate more differences between environmental activities to achieve more accurate prioritising. This study identified the level of environmental adoption and the most implemented environmental activities in the sample in the last five years by collecting data in 2017 because the delivery of several major government policy initiatives was the Department of Sustainability, Environment, Water, Population and Communities in Australia supported to promote the conservation and sustainable use of Australia's natural resources over the years 1 July 2012 to 30 June 2013 and diverse ongoing work program spanning environmental regulation, program delivery and scientific research were emphasised by this department (Horne 2014). Future research can find the distinct level of sustainable performance in logistics companies from reactive to proactive. In the AHP section, a comparison matrix can be developed to extract the importance weight of each environmental activity from the respondents' point of view for integrating to the prioritising process to have a more accurate ranking of environmental activities.

Future research can ask managers to determine to what extent each environmental activity can improve sustainable performance because the amount of improvement can differ from each activity and measure. Furthermore, since improving some measures of sustainable performance affect improving other measures of it, conducting research on examining these parallel effects among these measures is suggested for future research. This can be another way to find the most important measures of sustainable performance as well as the most influential environmentally focused activities in logistics.

Although the pre-test of the questionnaire showed that Question 32 for ranking the factors was clearly designed, the respondents showed some different responses. In terms of designing the questionnaire, it is suggested to consider using score 1 for the factor with the highest influence. The scale for ranking was from 1 to 12 and it was clearly explained that 12 was to be considered the most influential. However, the responses showed that some of the respondents used 1 and some others used 12 for the most influential factor. It seems that use of the word 'rank' may have confused them. Therefore, it is recommended that in future research 1 is used as the most influential in the ranking questions to avoid this type of issue.

7.6 Summary

Environmental activities are required to protect environment and can directly and/or indirectly improve the economic performance of companies. Implementing these activities can provide companies with an increase in market share and sales volume which may improve financial performance. When an environmental activity improves the measures of environmental performance such as energy consumption and material usage, some measures of economic performance such as costs savings are also improved simultaneously. Moreover, improving social performance measures such as community support and employee satisfaction, as well as work safety and labour health, can also enhance company reputation. This may result in increasing market share, sales volume and profitability. Since implementing these activities can improve the performance of a company and superior performance is a means of creating a competitive advantage, implementing environmental activities may create a competitive advantage for logistics companies in the market. For those companies that intend to be leading companies in the market, implementing environmental activities is not only a requirement or a response to pressure from the government and regulatory environment, but may achieve a competitive advantage and contribute to making the company a leader.

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APPENDIXES

Appendix A: Ethics application approval

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
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Fax: (03) 6226 7148
Katherine.Shaw@utas.edu.au

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

13 December 2017

Dr Stephen Cahoon
Sense-T
Private Bag 113

Dear Dr Cahoon

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: H0017020 - Environmental practices and competitive advantage

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 13 December 2017.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

A PARTNERSHIP PROGRAM IN CONJUNCTION WITH THE DEPARTMENT OF HEALTH AND HUMAN SERVICES

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Jude Vienna-Hallam
Ethics Administration Officer
Tasmania Social Sciences HREC

Appendix B: Thesis hypotheses

Hypotheses for investigating the effects of environmental activities on improving sustainable performance measures (72)

The use of environmentally-friendly energy sources

Hypothesis 1: The use of environmentally-friendly energy sources (such as solar power or wind power) improves company's market share.

Hypothesis 2: The use of environmentally-friendly energy sources (such as solar power or wind power) improves company's cost savings.

Hypothesis 3: The use of environmentally-friendly energy sources (such as solar power or wind power) improves company's sale volume.

Hypothesis 4: The use of environmentally-friendly energy sources (such as solar power or wind power) improves company's material usage.

Hypothesis 5: The use of environmentally-friendly energy sources (such as solar power or wind power) improves company's energy consumption.

Hypothesis 6: The use of environmentally-friendly energy sources (such as solar power or wind power) improves company's pollution control.

Hypothesis 7: The use of environmentally-friendly energy sources (such as solar power or wind power) improves company's work safety and labour health.

Hypothesis 8: The use of environmentally-friendly energy sources (such as solar power or wind power) improves company's employee satisfaction.

Hypothesis 9: The use of environmentally-friendly energy sources (such as solar power or wind power) improves company's community support.

Replacing old vehicles with energy-efficient types

Hypothesis 10: Replacing old vehicles with energy-efficient types improves company's market share.

Hypothesis 11: Replacing old vehicles with energy-efficient types improves company's cost savings.

Hypothesis 12: Replacing old vehicles with energy-efficient types improves company's sale volume.

Hypothesis 13: Replacing old vehicles with energy-efficient types improves company's material usage.

Hypothesis 14: Replacing old vehicles with energy-efficient types improves company's energy consumption.

Hypothesis 15: Replacing old vehicles with energy-efficient types improves company's pollution control.

Hypothesis 16: Replacing old vehicles with energy-efficient types improves company's work safety and labour health.

Hypothesis 17: Replacing old vehicles with energy-efficient types improves company's employee satisfaction.

Hypothesis 18: Replacing old vehicles with energy-efficient types improves company's community support.

Optimisation of distribution process

Hypothesis 19: Optimisation of distribution process improves company's market share.

Hypothesis 20: Optimisation of distribution process improves company's cost savings.

Hypothesis 21: Optimisation of distribution process improves company's sale volume.

Hypothesis 22: Optimisation of distribution process improves company's material usage.

Hypothesis 23: Optimisation of distribution process improves company's energy consumption.

Hypothesis 24: Optimisation of distribution process improves company's pollution control.

Hypothesis 25: Optimisation of distribution process improves company's work safety and labour health.

Hypothesis 26: Optimisation of distribution process improves company's employee satisfaction.

Hypothesis 27: Optimisation of distribution process improves company's community support.

The use of environmental management systems

Hypothesis 28: The use of environmental management systems improves company's market share.

Hypothesis 29: The use of environmental management systems improves company's cost savings.

Hypothesis 30: The use of environmental management systems improves company's sale volume.

Hypothesis 31: The use of environmental management systems improves company's material usage.

Hypothesis 32: The use of environmental management systems improves company's energy consumption.

Hypothesis 33: The use of environmental management systems improves company's pollution control.

Hypothesis 34: The use of environmental management systems improves company's work safety and labour health.

Hypothesis 35: The use of environmental management systems improves company's employee satisfaction.

Hypothesis 36: The use of environmental management systems improves company's community support.

Efficient storage of goods

Hypothesis 37: Efficient storage of goods improves company's market share.

Hypothesis 38: Efficient storage of goods improves company's cost savings.

Hypothesis 39: Efficient storage of goods improves company's sale volume.

Hypothesis 40: Efficient storage of goods improves company's material usage.

Hypothesis 41: Efficient storage of goods improves company's energy consumption.

Hypothesis 42: Efficient storage of goods improves company's pollution control.

Hypothesis 43: Efficient storage of goods improves company's work safety and labour health.

Hypothesis 44: Efficient storage of goods improves company's employee satisfaction.

Hypothesis 45: Efficient storage of goods improves company's community support.

The use of energy-efficient refrigerants

Hypothesis 46: The use of energy-efficient refrigerants improves company's market share.

Hypothesis 47: The use of energy-efficient refrigerants improves company's cost savings.

Hypothesis 48: The use of energy-efficient refrigerants improves company's sale volume.

Hypothesis 49: The use of energy-efficient refrigerants improves company's material usage.

Hypothesis 50: The use of energy-efficient refrigerants improves company's energy consumption.

Hypothesis 51: The use of energy-efficient refrigerants improves company's pollution control.

Hypothesis 52: The use of energy-efficient refrigerants improves company's work safety and labour health.

Hypothesis 53: The use of energy-efficient refrigerants improves company's employee satisfaction.

Hypothesis 54: The use of energy-efficient refrigerants improves company's community support.

Waste control

Hypothesis 55: Waste control improves company's market share.

Hypothesis 56: Waste control improves company's cost savings.

Hypothesis 57: Waste control improves company's sale volume.

Hypothesis 58: Waste control improves company's material usage.

Hypothesis 59: Waste control improves company's energy consumption.

Hypothesis 60: Waste control improves company's pollution control.

Hypothesis 61: Waste control improves company's work safety and labour health.

Hypothesis 62: Waste control improves company's employee satisfaction.

Hypothesis 63: Waste control improves company's community support.

Recycling packaging material

Hypothesis 64: Recycling packaging material improves company's market share.

Hypothesis 65: Recycling packaging material improves company's cost savings.

Hypothesis 66: Recycling packaging material improves company's sale volume.

Hypothesis 67: Recycling packaging material improves company's material usage.

Hypothesis 68: Recycling packaging material improves company's energy consumption.

Hypothesis 69: Recycling packaging material improves company's pollution control.

Hypothesis 70: Recycling packaging material improves company's work safety and labour health.

Hypothesis 71: Recycling packaging material improves company's employee satisfaction.

Hypothesis 72: Recycling packaging material improves company's community support.

Appendix C: Participants information sheet

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Participant Information Sheet [15/11/2017]

Environmental practices and competitive advantage

1. Invitation

You are invited to take part in a major research study focused on the adoption of environmental practices and how they can improve competitive advantage. This study is conducted by Sonia Sadeghian Esfahani, a Ph.D. candidate at the University of Tasmania under the supervision of Assoc. Prof Stephen Cahoon, Director, Sense-T at the University of Tasmania, Dr. Peggy Chen, Senior Lecturer and Dr. Hilary Pateman, Adjunct Senior Lecturer at the National Centre for Ports and Shipping, Australian Maritime College. The study is being undertaken as partial fulfillment of a Doctor of Philosophy degree in logistics management.

2. What is the purpose of this study?

This study aims to investigate the effects of implementing environmental practices on achieving a competitive advantage for Australian logistics companies. The factors influencing logistics companies to implement environmental practices will be identified.

3. Why have I been invited to participate?

As a senior logistics manager, your valuable experience, knowledge, and insights in terms of costs and benefits of environmental practices adoption will make a significant contribution to the purpose of this study. There are several convincing arguments on both sides (costs and benefits) on whether environmental practices should be implemented, which is why this study, the first of its kind, is attempting to evaluate these arguments by surveying senior managers.

4. What will I be asked to do?

You will be asked to spend around 20 minutes, at your own convenience, to complete an online survey. Most of questions can be answered by simply ticking a box. Please note that receiving your completed questionnaire implies your consent for participating in this survey.

5. Are there any possible benefits from participation in this study?

By being involved in the survey, you will be able to:

- understand the level of adoption of environmental practices by Australian logistics companies;
- identify the reasons why environmental practices should be adopted by logistics companies; and
- understand how specific environmental practices can provide a competitive advantage.

6. Are there any possible risks from participation in this study?

There are no risks anticipated with participation in this study.

7. What if I change my mind during or after the study?

Your involvement in this study is entirely voluntary and you have the right to withdraw or decline whenever you decide without any consequences. You can also skip any question you are unwilling to answer in the online survey Please be assured that all of your responses and information will be treated as strictly confidential, and your identity and the name of your company will be kept anonymous. However, since you will provide your data anonymously, it is not possible to eliminate your data from the survey.

8. What will happen to the information when this study is over?
Questionnaire responses will be stored electronically in a University password-protected computer within the Connell building, Launceston campus of the University of Tasmania. All information collected will be treated as strictly confidential by the researchers. All the electronic files will be secured in a University of Tasmania password-protected computer and will be deleted from computer hard-drives and servers, and electronic rubbish bins emptied. All files will be held securely for a minimum of 5 years following the publication of reports or articles resulting from data generation and then securely destroyed.

9. How will the results of the study be published?
The results from this study will be published in the form of a Ph.D. thesis. The findings may also be expected to be published at some conferences or other academic areas including scientific journals. A summary of the results will be provided upon request to any participant in this study.

10. What if I have questions about this study?
If you have any questions or would like to discuss more the study, please do not hesitate to contact the following people:

Student Investigator:
Sonia Sadeghian Esfahani
PhD candidate
University of Tasmania
Ph: 03 6226 2306
Email: soniase@utas.edu.au

Chief Investigator:
Associate Professor Stephen Cahoon
Director, Sense-T
University of Tasmania
Ph: 03 6226 2306
Email: stephen.cahoon@utas.edu.au

Co-investigator:
Dr Shu-Ling (Peggy) Chen
Senior Lecturer
University of Tasmania
Ph: 03 6324 9694
Email: pchen@utas.edu.au

Co-investigator:
Dr Hilary Pateman
Adjunct Senior Lecturer
University of Tasmania
Ph: 03 6226 2306
Email: h.pateman@amc.edu.au

Contact details for the Ethics Committee:
This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on 03 6226 6254 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number: H0017020

Thank you for taking the time to consider this study. This information sheet is for you to keep.

Appendix D: Pre-test

PRE-TEST

Dear <title> <name>

My name is Sonia Sadeghian Esfahani and I am a Ph.D student at the Department of Maritime and Logistics Management, Australian Maritime College, University of Tasmania. My supervisors are Assoc. Prof Stephen Cahoon, Director, Sense-T at the University of Tasmania, Dr. Peggy Chen, Senior Lecturer and Dr. Hilary Pateman, Adjunct Senior Lecturer at the National Centre for Ports and Shipping, Australian Maritime College. I am writing to request your participation in pretesting a web-based survey. Your valuable feedback will help this research to achieve high quality in developing the survey.

The aim of this research is to investigate the relationship between implementing environmental practices and achieving a competitive advantage. The research objectives will include:

- Identifying the factors influencing companies to adopt environmental activities, environmental activities in logistics and measures of sustainable performance.
- Developing a conceptual framework to evaluate the effects of implementing environmental activities on improving sustainable performance.
- Prioritising the factors influencing environmental adoption.
- Identifying the level of environmental adoption for logistics companies in Australia.

To achieve these objectives, the primary research question (PRQ) is:

- PRQ: Does adoption of environmental practices improve sustainable performance for logistics companies?

To address the PRQ, the following secondary research questions (SRQ) are:

- SRQ1: Which factors have a greater influence on logistics actors toward adopting environmental activities?
- SRQ2: Which environmental activities have been undertaken by Australian logistics companies in the last five years?
- SRQ3: Which environmental activities have a greater influence on improving sustainable performance for logistics companies?

The practical environment that this research investigates is the Australian logistics industry and I will send the web-based questionnaire to the senior managers of Australian logistics companies.

It would be greatly appreciated if you could complete all the attached documents and **return them on Friday 27 October 2017.** Please **send them to the email shown below** or **place them in the pigeon** hole for PhD students at the **Distance Education Office** of the MLM Department.

The key guidelines provided on the next page may be useful when undertaking the pre-testing.

If you have any question, please feel free to contact me via email at soniase@utas.edu.au or on 042

Thank you very much in advance for your support and input.

Best Regards,

Sonia Sadeghian Esfahani

Questions/issues for pre-testing the web-based survey and all other attached documents

Comments arising from your evaluation will be used to improve the questionnaire. Potential issues have been divided into three categories.

A. Layout

1. Does the layout of the questionnaire make it easy to read (for example font size and line spacing)?
2. Do the question numbers flow in a chronological order?
3. Are the questions in a logical order?
4. Are the transitions between sections smooth?
5. Are there any spelling and grammatical errors?

B. Completing the questionnaire

1. How long did the questionnaire take to read through and answer the questions?
2. Are any of the questions unclear or ambiguous?
3. Are any questions difficult to answer?
4. Did you object to answering any of the questions?
5. Is the language appropriate for the proposed sample?
6. Are any of the questions showing bias?

C. Purpose of the questionnaire

1. Did you consider that any major topics had been omitted?
2. Are any of the questions irrelevant that should therefore be omitted?
3. Did you understand the focus of the questionnaire?
4. Are there any other issues you'd like to comment on?

Source: Cahoon (2004, p. 454)

Appendix E: Invitation email

Invitation email

Dear manager

My name is Sonia Sadeghian Esfahani and I am a Ph.D. student at the University of Tasmania. I am writing to request your involvement in a major three year study focusing on the relationship between implementing environmental activities, which go beyond current regulatory requirements, and improving sustainable performance for logistics companies in Australia as partial fulfillment of my Doctor of Philosophy degree in logistics management. This research study is conducted under the supervision of Assoc. Prof Stephen Cahoon (Chief Investigator), Dr Peggy Chen and Dr Hilary Pateman (Co-investigators).

Over 296 senior managers in Australian logistics companies are being invited to participate in this survey. You are being invited because your valuable experience, knowledge, and insights can assist in achieving the objectives of this study.

Please note that this is an independent study and the first of its kind, which is being undertaken for academic purposes. Please note however, that the findings of this study will also provide useful outcomes for individual logistics companies like yours as well as the industry in general.

The study takes the form of a survey in which you will be asked to identify and rank the factors that influence your company to implement environmental activities. The survey is web-based and should take around **20 minutes** to complete.

Your involvement in this survey is entirely voluntary and you have the right to withdraw or decline during any part of the survey. Please be assured that all of your responses will be treated as **strictly confidential**, and your identity and the name of your company will be kept **anonymous.** Further information about the study is provided in the attached participant information sheet.

Receiving your completed questionnaire implies your consent to participate in this survey. If you would like to receive a copy of the survey's results when complete, please send an email to me at soniase@utas.edu.au (your email will be kept confidential).

If you are interesting in contributing to the findings of this major study that will provide valuable outcomes for your company and the logistics industry, please click on the link below to start the survey.

Survey address (URL)

https://www.surveymonkey.com/r/WKWQV53

If you have any question, please feel free to contact me, Sonia Sadeghian Esfahani via email at soniase@utas.edu.au or on 03 62262306.

Thank you very much in advance for your support and input.

Yours sincerely,

Sonia Sadeghian Esfahani
Ph.D. Candidate

University of Tasmania

UNIVERSITY of TASMANIA | AMC Australian Maritime College

Appendix F: Reminder email

Dear manager

We recently sent you an email requesting your assistance to complete a survey titled 'Environmental activities and sustainable performance'. If you have already completed the questionnaire, many thanks for your valuable input. If not, we would really appreciate your time to undertake the questionnaire via the below link.

Further information about the study is provided in the participant information sheet, which is attached.

As mentioned in the last email, your participation will add value to this research. By participating in the survey, you will be able to:

- understand the level of adoption of environmental activities by Australian logistics companies;
- identify the reasons why environmental activities should be adopted by logistics companies; and
- understand how specific environmental activities can improve the sustainable performance.

If you are able to assist this important study, please click here to access the survey

https://www.surveymonkey.com/r/WKWQV53

Please let us know if you have any questions via email at soniase@utas.edu.au or on 03 62262306. Thanks in advance for your cooperation.

Kind regards,

Sonia Sadeghian Esfahani
Ph.D. Candidate

University of Tasmania

UNIVERSITY of TASMANIA | AMC Australian Maritime College

Appendix G: Survey questionnaire

Welcome to this Survey

Thank you for taking your time to add value to this study.
There are several convincing arguments on both sides (costs and benefits) on whether

environmental activities should be implemented, which is why this study, the first of its kind, is attempting to evaluate these arguments by surveying senior managers. Thus, your valuable experience, knowledge, and insights in terms of costs and benefits of environmental activities will

make a significant contribution to the purpose of this study.

You and your company

1. What is your position in your company?

- Chief executive officer
- General manager
- Operational manager
- Logistics manager
- Managing director
- Other (please specify)

2. How many years of experience do you have in management positions in your current company?

- Less than 5 years
- 6-10 years
- 11-20 years
- More than 20 years

3. Which types of logistics services below are offered by your company? (Tick all that apply)

- Freight transport
- Packaging and labelling
- Warehouse and storage
- Distribution
- Consultancy and project services

Other (please specify)

4. How many employees (by headcount) does your company have in Australia?

- 1-4 employees
- 100-149 employees
- 5-19 employees
- 150-199 employees
- 20-49 employees
- 200 or more employees
- 50-99 employees

5. What is the annual revenue of your company in Australia?

- $2 million or less
- Over $2 to $10 million
- Over $10 to less than $25 million
- $25 million or above
- Prefer not to answer

6. Please indicate which of the following environmentally friendly energy sources are used by your company.

- Wind power
- Solar power
- Tidal power
- Non are used
- Other (please specify)

Economic competitive advantages

This section evaluates the relationship between implementing environmental activities and improving economic performance in your company.

Please indicate your level of agreement with the following statements.

7. The use of environmentally friendly energy sources (such as solar power or wind power) improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Market share						
Costs saving						
Sales volume						

8. Replacing old vehicles with energy efficient vehicles improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Market share						
Costs saving						
Sale volume						

9. Optimisation of the distribution process through better routeing and scheduling improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Market share						
Costs saving						
Sales volume						

10. The use of environmental management systems such as ISO standards improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Market share						
Costs saving						
Sales volume						

11. Efficient storage of goods improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Market share						
Costs saving						
Sales volume						

12. Use of energy-efficient refrigerant improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Market share						
Costs saving						
Sales volume						

13. Waste control improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Market share						
Costs saving						
Sales volume						

14. Recycling packaging materials improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Market share						
Costs saving						
Sales volume						

Environmental competitive advantages

This section evaluates the relationship between implementing environmental activities and improving environmental performance in your company.
Please indicate your level of agreement with the following statements. Some questions seem similar but they are assessing different comparisons.

15. The use of environmentally friendly energy sources (such as solar power or wind power) improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Material usage	○	○	○	○	○	○
Energy consumption	○	○	○	○	○	○
Pollution control	○	○	○	○	○	○

16. Replacing old vehicles with energy efficient vehicles improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Material usage	○	○	○	○	○	○
Energy consumption	○	○	○	○	○	○
Pollution control	○	○	○	○	○	○

17. Optimisation of the distribution process through better routeing and schedulingimproves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Material usage	○	○	○	○	○	○
Energy consumption	○	○	○	○	○	○
Pollution control	○	○	○	○	○	○

18. The use of environmental management systems such as ISO standards improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Material usage	○	○	○	○	○	○
Energy consumption	○	○	○	○	○	○
Pollution control	○	○	○	○	○	○

19. Efficient storage of goods improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Material usage	◯	◯	◯	◯	◯	◯
Energy consumption	◯	◯	◯	◯	◯	◯
Control of pollution	◯	◯	◯	◯	◯	◯

20. Use of energy efficient refrigerant improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Material usage	◯	◯	◯	◯	◯	◯
Energy consumption	◯	◯	◯	◯	◯	◯
Pollution control	◯	◯	◯	◯	◯	◯

21. Waste control improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Material usage	◯	◯	◯	◯	◯	◯
Energy consumption	◯	◯	◯	◯	◯	◯
Pollution control	◯	◯	◯	◯	◯	◯

22. Recycling packaging materials improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Material usage	◯	◯	◯	◯	◯	◯
Energy consumption	◯	◯	◯	◯	◯	◯
Pollution control	◯	◯	◯	◯	◯	◯

Social competitive advantages

This section evaluates the relationship between implementing environmental activities and improving social performance in your company.

Please indicate your level of agreement with the following statements. Some questions seem similar but they are assessing different comparisons.

23. The use of environmentally friendly energy sources (such as solar power or wind power) improves my company's:

	strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Work safety and labour health						
Employee satisfaction						
Community support						

24. Replacing old vehicles with energy efficient vehicles improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Work safety and labour health						
Employee satisfaction						
Community support						

25. Optimisation of the distribution process through better routeing and scheduling improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Work safety and labour health						
Employee satisfaction						
Community support						

26. The use of environmental management systems such as ISO standards improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Work safety and labour health						
Employee satisfaction						
Community support						

27. Efficient storage of goods improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Work safety and labour health						
Employee satisfaction						
Community support						

28. Use of energy-efficient refrigerant improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Work safety and labour health						
Employee satisfaction						
Community support						

29. Waste control improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Work safety and labour health						
Employee satisfaction						
Community support						

30. Recycling packaging materials improves my company's:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Don't know
Work safety and labour health						
Employee satisfaction						
Community support						

Factors influencing environmental adoption

This section requests you to identify and rank the influencing factors with a greater effect on your company towards adopting environmental activities.

31. To what extent does each factor below influence your company's willingness to implement environmental activities?

	No extent	little extent	Some extent	A great extent	Total extent	Don't know
Employees interested in environmental adoption	○	○	○	○	○	○
Accumulation of new technologies	○	○	○	○	○	○
Supplier pressure	○	○	○	○	○	○
Customer pressure	○	○	○	○	○	○
Competitor pressure	○	○	○	○	○	○
Government pressure	○	○	○	○	○	○
Company growing in size	○	○	○	○	○	○
Governmental regulations	○	○	○	○	○	○
Demand for environmentally-friendly logistics services	○	○	○	○	○	○
Social awareness	○	○	○	○	○	○
Increasing fuel and energy prices	○	○	○	○	○	○
Potential for achieving competitive advantage	○	○	○	○	○	○

32. Which of the following factors are most likely to influence your company to adopt environmental activities? Please rank. (12 being the most influential)

☐	Employees interested in environmental adoption
☐	Accumulation of new technologies
☐	Supplier pressure
☐	Customer pressure
☐	Competitor pressure
☐	Government pressure
☐	Company growing in size
☐	Governmental regulations
☐	Demand for environmentally-friendly logistics services
☐	Social awareness
☐	Increasing fuel and energy prices
☐	Potential for achieving competitive advantage

33. Are there other factors influencing your company's adoption of environmental activities, not mentioned in the above list?

34. Which of the following environmental practices have been implemented by your company in the last five years?

- [ ] The use of environmentally friendly energy sources (such as solar power or wind power)
- [ ] Replacing old vehicles with energy efficient vehicles
- [ ] Optimisation of the distribution process through better scheduling
- [ ] The use of environmental management system such as ISO standard
- [ ] Efficient storage of goods
- [ ] Use of energy efficient refrigerant
- [ ] Waste control
- [ ] Recycling packaging material
- [ ] None of them

Other (please specify)

Ranking the measures of performance

Please indicate the level of importance of each performance measure when it is compared with another performance measure in the following questions.

35. How important is economic performance when compared with the environmental performance?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know
○	○	○	○	○	○

36. How important is economic performance when compared with the social performance?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know
○	○	○	○	○	○

37. How important is environmental performance when compared with the social performance?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know
○	○	○	○	○	○

38. How important is market share when compared with the sales volume?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know
○	○	○	○	○	○

39. How important is market share when compared with the costs saving?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know
○	○	○	○	○	○

40. How important is costs saving when compared with the sales volume?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know
○	○	○	○	○	○

41. How important is material usage when compared with the energy consumption?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know
○	○	○	○	○	○

42. How important is material usage when compared with the pollution control?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know

43. How important is energy consumption when compared with the pollution control?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know

44. How important is work safety and labour health when compared with the employee satisfaction?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know

45. How important is work safety and labour health when compared with the community support?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know

46. How important is employee satisfaction when compared with the community support?

Extremely less important	Moderately less important	Equally important	Moderately more important	Extremely more important	Don't know

Thank you for completing our survey.

We appreciate your participation and the valuable time with completing the survey. Submitting this survey confirms your consent for the information you have provided to be used in this research.

Appendix H: Reliability, T-student, EFA and Friedman results

The use of environmentally-friendly energy sources

Reliability Statistics

Cronbach's Alpha	N of Items
.874	9

Replacing old vehicles with energy-efficient types

Reliability Statistics

Cronbach's Alpha	N of Items
.890	9

Optimisation of the distribution process

Reliability Statistics

Cronbach's Alpha	N of Items
.848	9

Use of environmental management system

Reliability Statistics

Cronbach's Alpha	N of Items
.953	9

Efficient storage of goods

Reliability Statistics

Cronbach's Alpha	N of Items
.927	9

Use of energy-efficient refrigerant

Reliability Statistics

Cronbach's Alpha	N of Items
.951	9

Waste Control

Reliability Statistics

Cronbach's Alpha	N of Items
.877	9

Recycling packaging material

Reliability Statistics

Cronbach's Alpha	N of Items
.891	9

Question 31: Scoring influencing factors

Reliability Statistics

Cronbach's Alpha	N of Items
.754	12

Question 32: Ranking influencing factors

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
78.0000	.000	.00000	12

Pairwise comparison questions

Reliability Statistics

Cronbach's Alpha	N of Items
.754	12

Non-response bias- T-test

Independent Samples Test

		t-test for Equality of Means	
		t	Sig. (2-tailed)
cq	Equal variances assumed	.621	.538

T-student test results: The use of environmentally-friendly energy sources

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Market. Share	-1.851	72	.068	-.28767	-.5975	.0222
Costs saving	3.077	73	.003	.52703	.1857	.8684
Sale volume	-2.458	72	.016	-.36986	-.6698	-.0699
Material usage	1.239	69	.220	.18571	-.1134	.4848
Energy consumption	3.067	69	.003	.52857	.1848	.8724
Pollution control	7.278	69	.000	1.08571	.7881	1.3833
Work safety and labour health	.894	65	.375	.13636	-.1682	.4409
Employee satisfaction	2.818	65	.006	.37879	.1103	.6473
Community support	5.408	65	.000	.77273	.4874	1.0581

T-student test results: Replacing old vehicles

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Market. Share	.928	73	.357	.13514	-.1552	.4255
Costs saving	7.459	73	.000	1.09459	.8021	1.3871
Sale volume	.351	72	.726	.05479	-.2560	.3656
Material usage	4.460	69	.000	.67143	.3711	.9717
Energy consumption	7.490	69	.000	1.08571	.7965	1.3749
Pollution control	8.534	69	.000	1.21429	.9304	1.4981
Work safety and labour health	5.350	65	.000	.74242	.4653	1.0196
Employee satisfaction	10.436	65	.000	1.19697	.9679	1.4260
Community support	7.822	65	.000	.96970	.7221	1.2173

T-student test results: Optimisation of the distribution process

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Market. Share	6.831	73	.000	.93243	.6604	1.2045
Costs saving	12.569	73	.000	1.43243	1.2053	1.6596
Sale volume	7.774	73	.000	.98649	.7336	1.2394
Material usage	8.925	69	.000	1.05714	.8208	1.2935
Energy consumption	11.236	69	.000	1.27143	1.0457	1.4972
Pollution control	8.400	69	.000	1.17143	.8932	1.4496
Work safety and labour health	10.708	65	.000	1.12121	.9121	1.3303
Employee satisfaction	11.571	65	.000	1.15152	.9528	1.3503
Community support	3.628	65	.001	.51515	.2316	.7987

T-student test results: Use of environmental management system

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Market. Share	3.527	73	.001	.51351	.2234	.8037
Costs saving	2.763	72	.007	.38356	.1069	.6603
Sale volume	2.599	72	.011	.35616	.0829	.6294
Material usage	3.194	68	.002	.47826	.1794	.7771
Energy consumption	2.907	68	.005	.43478	.1363	.7332
Pollution control	3.265	68	.002	.50725	.1972	.8173
Work safety and labour health	3.335	65	.001	.53030	.2128	.8478
Employee satisfaction	3.139	65	.003	.53030	.1929	.8677
Community support	1.449	65	.152	.22727	-.0861	.5406

T-student test results: Efficient storage of goods

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Market. Share	5.401	73	.000	.72973	.4605	.9990
Costs saving	9.812	73	.000	1.18919	.9476	1.4307
Sale volume	5.547	72	.000	.69863	.4476	.9497
Material usage	5.043	69	.000	.75714	.4576	1.0567
Energy consumption	4.381	69	.000	.67143	.3657	.9772
Pollution control	3.801	69	.000	.57143	.2715	.8713
Work safety and labour health	5.719	65	.000	.81818	.5324	1.1039
Employee satisfaction	5.880	65	.000	.78788	.5203	1.0555
Community support	.701	65	.486	.10606	-.1962	.4083

T-student test results: Use of energy-efficient refrigerant

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Market. Share	-2.049	72	.044	-.35616	-.7026	-.0097
Costs saving	1.711	72	.091	.32877	-.0543	.7119
Sale volume	-2.292	71	.025	-.38889	-.7271	-.0506
Material usage	-1.320	68	.191	-.26087	-.6553	.1335
Energy consumption	1.693	69	.095	.37143	-.0661	.8090
Pollution control	1.000	69	.321	.21429	-.2132	.6418
Work safety and labour health	-.310	65	.757	-.06061	-.4508	.3296
Employee satisfaction	-.549	65	.585	-.10606	-.4921	.2799
Community support	-1.157	65	.252	-.22727	-.6196	.1651

T-student test results: Waste control

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Market. Share	.564	73	.574	.08108	-.2053	.3674
Costs saving	5.829	72	.000	.83562	.5498	1.1214
Sale volume	-.591	72	.556	-.08219	-.3592	.1948
Material usage	6.063	69	.000	.88571	.5943	1.1772
Energy consumption	3.482	69	.001	.54286	.2319	.8538
Pollution control	6.622	69	.000	.97143	.6788	1.2641
Work safety and labour health	3.858	65	.000	.51515	.2485	.7818
Employee satisfaction	4.267	65	.000	.57576	.3063	.8453
Community support	5.544	65	.000	.84848	.5428	1.1541

T-student test results: Recycling packaging material

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Market. Share	.536	74	.593	.08000	-.2173	.3773
Costs saving	5.171	73	.000	.67568	.4153	.9361
Sale volume	-.790	72	.432	-.10959	-.3861	.1669
Material usage	4.910	69	.000	.75714	.4495	1.0648
Energy consumption	2.038	69	.045	.30000	.0063	.5937
Pollution control	5.409	69	.000	.84286	.5320	1.1537
Work safety and labour health	.485	65	.629	.07576	-.2361	.3876
Employee satisfaction	1.835	65	.071	.28788	-.0254	.6011
Community support	4.071	65	.000	.68182	.3474	1.0163

Factor analysis for question 31: influencing factors

Factor Analysis- The first run

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.818
Bartlett's Test of Sphericity	Approx. Chi-Square	393.021
	df	66
	Sig.	.000

Communalities

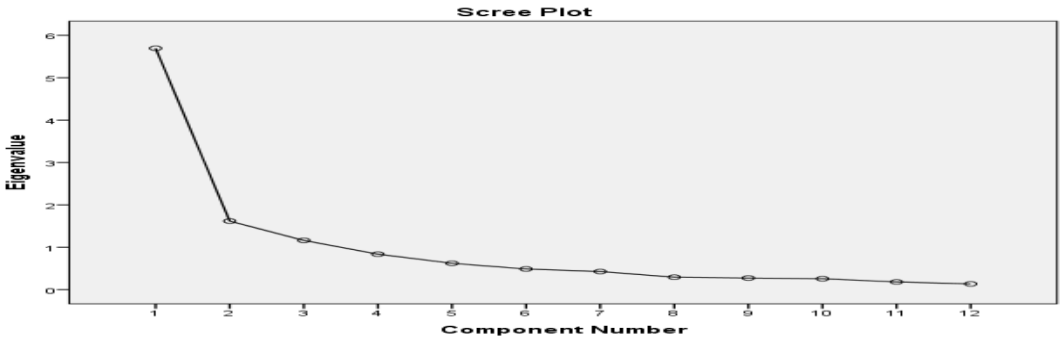
	Initial	Extraction
Employee interest	1.000	.519
Technology	1.000	.640
Supplier pressure	1.000	.691
Customer pressure	1.000	.710
Competitor pressure	1.000	.721
Gov. pressure	1.000	.741
Size	1.000	.799
Gov. regulation	1.000	.797
Social awareness	1.000	.755
Energy price	1.000	.589
Competitive advantage	1.000	.772
Env. demand	1.000	.740

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.694	47.450	47.450	5.694	47.450	47.450	3.315	27.627	27.627
2	1.618	13.484	60.934	1.618	13.484	60.934	2.582	21.520	49.147
3	1.163	9.689	70.623	1.163	9.689	70.623	2.577	21.476	70.623
4	.838	6.982	77.605						
5	.622	5.182	82.787						
6	.488	4.065	86.852						
7	.428	3.567	90.419						
8	.295	2.462	92.881						
9	.275	2.292	95.173						
10	.259	2.155	97.329						
11	.184	1.529	98.858						
12	.137	1.142	100.000						

Extraction Method: Principal Component Analysis.



Component Matrix [a]

	Component 1	2	3
Env. demand	.831	.220	-.043
Competitive advantage	.812	-.334	-.039
Company size	.811	-.372	.050
Customer pressure	.776	.317	.087
Competitor pressure	.770	.280	.221
Social awareness	.733	-.465	-.047
Technology	.670	.384	.207
Gov. pressure	.653	.307	-.469
Gov. regulation	.638	.237	-.578
Energy price	.592	-.488	-.030
Employees interest	.425	-.476	.335
Supplier pressure	.376	.401	.624

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

Rotated Component Matrix [a]

	Component 1	2	3
Social awareness	.819	.104	.271
Company size	.811	.258	.274
Competitive advantage	.773	.223	.355
Energy price	.748	.026	.172
Employees interest	.671	.179	-.191
Supplier pressure	.011	.822	-.124
Competitor pressure	.311	.706	.354
Technology	.166	.702	.347
Customer pressure	.272	.643	.472
Gov. regulation	.168	.098	.871
Gov. pressure	.138	.215	.822
Env. demand	.366	.535	.566

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

Component Transformation Matrix

Component	1	2	3
1	.646	.532	.547
2	-.755	.551	.356
3	.112	.643	-.758

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Factor Analysis- Second run

Communalities

	Initial	Extraction
Employees interest_	1.000	.506
Technology	1.000	.632
Supplier pressure	1.000	.703
Customer pressure	1.000	.707
Competitor pressure	1.000	.726
Gov. pressure	1.000	.765
Company size	1.000	.800
Gov. regulation	1.000	.828
Social awareness	1.000	.751
Energy	1.000	.593
Competitive advantage	1.000	.773

Extraction Method: Principal Component Analysis.

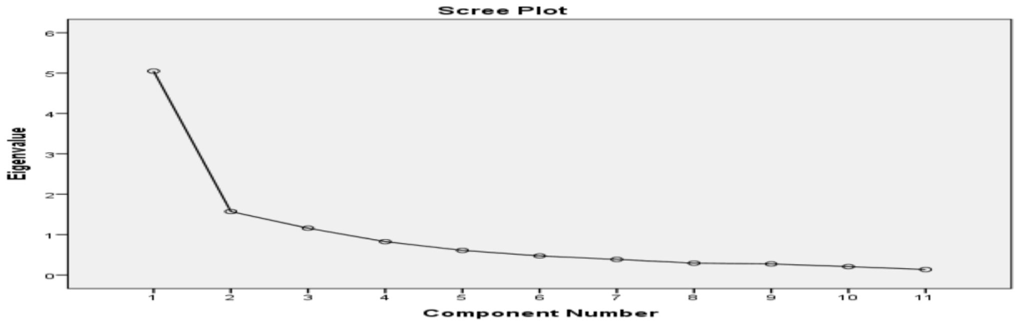
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.784
Bartlett's Test of Sphericity	Approx. Chi-Square	332.562
	df	55
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.049	45.904	45.904	5.049	45.904	45.904	3.242	29.468	29.468
2	1.572	14.294	60.199	1.572	14.294	60.199	2.311	21.007	50.475
3	1.161	10.554	70.753	1.161	10.554	70.753	2.231	20.277	70.753
4	.827	7.523	78.275						
5	.611	5.554	83.829						
6	.475	4.316	88.146						
7	.388	3.523	91.669						
8	.295	2.684	94.353						
9	.275	2.499	96.852						
10	.209	1.899	98.752						
11	.137	1.248	100.000						

Extraction Method: Principal Component Analysis.



Component Matrix [a]

	Component		
	1	2	3
Company size	.828	-.333	.050
Competitive advantage	.826	-.298	-.038
Competitor pressure	.761	.321	.209
Customer pressure	.760	.351	.076
Social awareness	.744	-.443	-.040
Technology	.650	.414	.196
Gov. pressure	.643	.339	-.486
Gov. regulation	.635	.271	-.593
Energy	.615	-.462	-.023
Employees interest	.463	-.427	.331
Supplier pressure	.371	.442	.608

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

Rotated Component Matrix [a]

	Component		
	1	2	3
Social awareness	.827	.090	.244
Company size	.817	.254	.259
Competitive advantage	.781	.219	.339
Energy	.753	.024	.158
Employees interest	.662	.187	-.180
Supplier pressure	.012	.830	-.115
Competitor pressure	.324	.708	.346
Technology	.179	.698	.335
Customer pressure	.287	.642	.460
Gov. regulation	.181	.114	.885
Gov. pressure	.151	.226	.831

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

Component Transformation Matrix

Component	1	2	3
1	.694	.508	.510
2	-.711	.595	.375
3	.113	.623	-.774

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Factor analysis for question 32: ranking influencing factors

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.215
Bartlett's Test of Sphericity	Approx. Chi-Square	204.687
	df	55
	Sig.	.000

Friedman Test

Test Statistics[a]

N	58
Chi-Square	114.753
df	11
Asymp. Sig.	.000

a. Friedman Test

Ranks by Friedman Test

	Mean Rank
Employee interest	4.77
Accumulation of technology	6.38
Supplier pressure	4.57
Customer pressure	7.56
Competitor pressure	5.98
Government pressure	7.14
Company size	4.85
Governmental Regulation	8.82
Environmental demand	6.19
Social awareness	6.22
Increasing in fuel and energy prices	7.81
Potential for achieving a competitive advantage	7.72

Appendix I: Mean tests of sustainable performance measures

Means of sustainable performance measure for each logistics services

1. Freight forwarding

	N	Minimum	Maximum	Mean	Std. Deviation
Market.share.q1	18	.00	4.00	3.0556	1.05564
Costs.saving.q1	18	.00	5.00	3.3889	1.57700
Sale.volume.q1	18	.00	5.00	3.0556	1.21133
Material.usage.q1	16	.00	5.00	3.0625	1.18145
Energy.consumption.q1	16	.00	5.00	3.3125	1.62147
Pollution.control.q1	16	.00	5.00	3.5625	1.54785
Work.safety.and.labour.health.q1	16	.00	4.00	2.8125	1.37689
Employee.satisfaction.q1	16	.00	4.00	3.0625	1.43614
Community.support.q1	16	.00	5.00	3.3750	1.45488
Market.share.q2	18	2.00	5.00	3.2778	.82644
Costs.saving.q2	18	2.00	5.00	4.0556	.72536
Sale.volume.q2	18	2.00	5.00	3.4444	.85559
Material.usage.q2	16	2.00	5.00	3.7500	.85635
Energy.consumption.q2	16	2.00	5.00	4.0625	.68007
Pollution.control.q2	16	3.00	5.00	4.2500	.57735
Work.safety.and.labour.health.q2	16	3.00	5.00	3.8125	.65511
Employee.satisfaction.q2	16	4.00	5.00	4.2500	.44721
Community.support.q2	16	3.00	5.00	4.1250	.50000
Market.share.q3	18	3.00	5.00	4.1111	.58298
Costs.saving.q3	18	4.00	5.00	4.5000	.51450
Sale.volume.q3	18	3.00	5.00	4.1111	.67640
Material.usage.q3	16	3.00	5.00	3.9375	.68007
Energy.consumption.q3	16	4.00	5.00	4.4375	.51235
Pollution.control.q3	16	4.00	5.00	4.2500	.44721

Work.safety.and.labour.health.q3	16	3.00	5.00	4.2500	.57735
Employee.satisfaction.q3	16	3.00	5.00	4.1250	.50000
Community.support.q3	16	.00	5.00	3.5000	1.15470
Market.share.q4	18	.00	5.00	3.6667	1.32842
Costs.saving.q4	18	.00	5.00	3.5000	1.29479
Sale.volume.q4	18	.00	5.00	3.6111	1.24328
Material.usage.q4	16	.00	5.00	3.3750	1.20416
Energy.consumption.q4	16	.00	5.00	3.5000	1.21106
Pollution.control.q4	16	.00	5.00	3.3750	1.20416
Work.safety.and.labour.health.q4	16	.00	5.00	3.4375	1.59034
Employee.satisfaction.q4	16	.00	5.00	3.3125	1.57982
Community.support.q4	16	.00	5.00	3.4375	1.54785
Market.share.q5	18	.00	5.00	3.5000	1.24853
Costs.saving.q5	18	.00	5.00	4.0556	1.16175
Sale.volume.q5	18	.00	5.00	3.6111	1.14475
Material.usage.q5	16	.00	5.00	3.8750	1.20416
Energy.consumption.q5	16	.00	5.00	3.6875	1.19548
Pollution.control.q5	16	.00	5.00	3.6250	1.20416
Work.safety.and.labour.health.q5	16	.00	5.00	4.0000	1.26491
Employee.satisfaction.q5	16	.00	5.00	3.9375	1.23659
Community.support.q5	16	.00	5.00	3.0625	1.38894
Market.share.q6	18	.00	5.00	3.1667	1.15045
Costs.saving.q6	18	.00	5.00	3.7778	1.21537
Sale.volume.q6	18	.00	5.00	3.2778	1.07406
Material.usage.q6	16	.00	5.00	3.3125	1.40089
Energy.consumption.q6	16	.00	5.00	3.8125	1.60078
Pollution.control.q6	16	.00	5.00	3.6250	1.50000
Work.safety.and.labour.health.q6	16	.00	5.00	3.1250	1.36015
Employee.satisfaction.q6	16	.00	5.00	3.1875	1.37689
Community.support.q6	16	.00	5.00	3.0625	1.34009
Market.share.q7	18	2.00	5.00	3.5556	.92178

Costs.saving.q7	18	3.00	5.00	3.9444	.53930
Sale.volume.q7	18	2.00	5.00	3.4444	.85559
Material.usage.q7	16	3.00	5.00	4.0625	.77190
Energy.consumption.q7	16	3.00	5.00	3.9375	.68007
Pollution.control.q7	16	2.00	5.00	3.8750	.88506
Work.safety.and.labour.health.q7	16	.00	5.00	3.4375	1.09354
Employee.satisfaction.q7	16	.00	5.00	3.6250	1.08781
Community.supportq7	16	.00	5.00	3.6875	1.57982
Market.share.q8	18	.00	5.00	2.8889	1.60473
Costs.saving.q8	18	.00	5.00	3.3889	1.53925
Sale.volume.q8	18	.00	5.00	2.7222	1.52646
Material.usage.q8	16	2.00	5.00	4.0000	1.09545
Energy.consumption.q8	16	2.00	5.00	3.7500	.93095
Pollution.control.q8	16	2.00	5.00	4.0625	.99791
Work.safety.and.labour.health.q8	16	.00	5.00	2.8125	1.32759
Employee.satisfaction.q8	16	.00	5.00	2.9375	1.65202
Community.support.q8	16	.00	5.00	3.2500	1.69312
Valid N (listwise)	16				

2. Packaging and labelling

	N	Minimum	Maximum	Mean	Std. Deviation
Market.share.q1	37	.00	5.00	2.8108	1.22106
Costs.saving.q1	38	.00	5.00	3.6053	1.48031
Sale.volume.q1	37	.00	5.00	2.6757	1.22597
Material.usage.q1	36	.00	5.00	3.3056	1.32707
Energy.consumption.q1	36	.00	5.00	3.6111	1.59065
Pollution.control.q1	36	.00	5.00	4.1944	1.23796
Work.safety.and.labour.health.q1	34	.00	5.00	3.1176	1.17460

Employee.satisfaction.q1	34	.00	5.00	3.3235	1.17346
Community.support.q1	34	.00	5.00	3.6471	1.22802
Market.share.q2	37	.00	5.00	3.2973	.96796
Costs.saving.q2	38	.00	5.00	4.2632	1.00497
Sale.volume.q2	37	.00	5.00	3.2703	1.17020
Material.usage.q2	36	.00	5.00	3.7778	1.14919
Energy.consumption.q2	36	.00	5.00	4.2500	.99642
Pollution.control.q2	36	.00	5.00	4.3889	.93435
Work.safety.and.labour.health.q2	34	1.00	5.00	3.8235	.83378
Employee.satisfaction.q2	34	4.00	5.00	4.3529	.48507
Community.support.q2	34	3.00	5.00	4.1765	.62622
Market.share.q3	37	3.00	5.00	4.1892	.61634
Costs.saving.q3	38	4.00	5.00	4.6053	.49536
Sale.volume.q3	38	3.00	5.00	4.2368	.63392
Material.usage.q3	36	2.00	5.00	4.1111	.82038
Energy.consumption.q3	36	3.00	5.00	4.5000	.60945
Pollution.control.q3	36	.00	5.00	4.3333	.92582
Work.safety.and.labour.health.q3	34	3.00	5.00	4.2353	.60597
Employee.satisfaction.q3	34	3.00	5.00	4.2353	.55371
Community.support.q3	34	.00	5.00	3.7353	1.02422
Market.share.q4	37	.00	5.00	3.8108	1.12640
Costs.saving.q4	37	.00	5.00	3.5676	1.06824
Sale.volume.q4	37	.00	5.00	3.6216	1.00971
Material.usage.q4	35	.00	5.00	3.6286	1.21476
Energy.consumption.q4	35	.00	5.00	3.6571	1.23533
Pollution.control.q4	35	.00	5.00	3.6286	1.26225
Work.safety.and.labour.health.q4	34	.00	5.00	3.5882	1.18367
Employee.satisfaction.q4	34	.00	5.00	3.3824	1.20641
Community.support.q4	34	.00	5.00	3.6471	1.27641
Market.share.q5	37	2.00	5.00	3.9459	.88021
Costs.saving.q5	38	3.00	5.00	4.4211	.59872

Sale.volume.q5	37	3.00	5.00	3.9730	.76327
Material.usage.q5	36	.00	5.00	4.0833	.93732
Energy.consumption.q5	36	.00	5.00	3.9722	1.02779
Pollution.control.q5	36	.00	5.00	3.8611	1.01848
Work.safety.and.labour.health.q5	34	2.00	5.00	4.1471	.74396
Employee.satisfaction.q5	34	3.00	5.00	4.0882	.71213
Community.support.q5	34	.00	5.00	3.4118	1.01854
Market.share.q6	37	.00	5.00	3.1351	1.20559
Costs.saving.q6	38	.00	5.00	3.7632	1.34434
Sale.volume.q6	37	.00	5.00	3.1351	1.13437
Material.usage.q6	35	.00	5.00	3.2857	1.42605
Energy.consumption.q6	36	.00	5.00	3.8333	1.52128
Pollution.control.q6	36	.00	5.00	3.7222	1.52336
Work.safety.and.labour.health.q6	34	.00	5.00	3.3529	1.32304
Employee.satisfaction.q6	34	.00	5.00	3.3824	1.30302
Community.support.q6	34	.00	5.00	3.2353	1.32708
Market.share.q7	37	.00	5.00	3.4595	.98867
Costs.saving.q7	38	.00	5.00	4.1053	.92384
Sale.volume.q7	37	.00	5.00	3.3784	.95310
Material.usage.q7	36	.00	5.00	4.1667	1.00000
Energy.consumption.q7	36	.00	5.00	3.7500	1.13074
Pollution.control.q7	36	.00	5.00	4.0000	1.12122
Work.safety.and.labour.health.q7	34	.00	5.00	3.5000	1.05169
Employee.satisfaction.q7	34	.00	5.00	3.6765	1.00666
Community.supportq7	34	.00	5.00	3.7941	1.27397
Market.share.q8	38	.00	5.00	3.3421	1.25798
Costs.saving.q8	38	.00	5.00	3.8684	1.09473
Sale.volume.q8	37	.00	5.00	3.1351	1.18233
Material.usage.q8	36	.00	5.00	4.1389	1.12511
Energy.consumption.q8	36	.00	5.00	3.6667	1.14642
Pollution.control.q8	36	.00	5.00	4.0000	1.19523

Work.safety.and.labour.health.q8	34	.00	5.00	3.1765	.99911
Employee.satisfaction.q8	34	.00	5.00	3.5000	1.18705
Community.support.q8	34	.00	5.00	3.7353	1.21378
Valid N (listwise)	33				

3. Storage and warehousing

	N	Minimum	Maximum	Mean	Std. Deviation
Market.share.q1	45	.00	5.00	2.8000	1.19848
Costs.saving.q1	44	.00	5.00	3.5000	1.50194
Sale.volume.q1	44	.00	5.00	2.6364	1.18304
Material.usage.q1	42	.00	5.00	3.2857	1.21546
Energy.consumption.q1	42	.00	5.00	3.5000	1.48570
Pollution.control.q1	42	.00	5.00	4.0714	1.21761
Work.safety.and.labour.health.q1	40	.00	5.00	3.1500	1.12204
Employee.satisfaction.q1	40	.00	5.00	3.2500	1.10361
Community.support.q1	40	.00	5.00	3.6000	1.21529
Market.share.q2	45	.00	5.00	3.2444	.98062
Costs.saving.q2	44	.00	5.00	4.1364	1.04750
Sale.volume.q2	44	.00	5.00	3.1364	1.15317
Material.usage.q2	42	.00	5.00	3.7857	1.11608
Energy.consumption.q2	42	.00	5.00	4.2143	1.00087
Pollution.control.q2	42	.00	5.00	4.3571	.95818
Work.safety.and.labour.health.q2	40	1.00	5.00	3.8250	.81296
Employee.satisfaction.q2	40	2.00	5.00	4.2750	.64001
Community.support.q2	40	2.00	5.00	4.0750	.69384
Market.share.q3	45	1.00	5.00	4.1111	.83182
Costs.saving.q3	44	1.00	5.00	4.4773	.82091
Sale.volume.q3	44	1.00	5.00	4.1136	.84126

Material.usage.q3	42	2.00	5.00	4.1190	.80251
Energy.consumption.q3	42	3.00	5.00	4.4048	.66478
Pollution.control.q3	42	.00	5.00	4.2857	.91826
Work.safety.and.labour.health.q3	40	2.00	5.00	4.1250	.68641
Employee.satisfaction.q3	40	2.00	5.00	4.1500	.66216
Community.support.q3	40	.00	5.00	3.5250	1.13199
Market.share.q4	45	.00	5.00	3.7333	1.13618
Costs.saving.q4	44	.00	5.00	3.4773	1.06724
Sale.volume.q4	44	.00	5.00	3.5227	1.02273
Material.usage.q4	42	.00	5.00	3.5714	1.12927
Energy.consumption.q4	42	.00	5.00	3.5714	1.15067
Pollution.control.q4	42	.00	5.00	3.5952	1.19060
Work.safety.and.labour.health.q4	40	.00	5.00	3.5750	1.21713
Employee.satisfaction.q4	40	.00	5.00	3.3500	1.18862
Community.support.q4	40	.00	5.00	3.6500	1.27199
Market.share.q5	45	.00	5.00	3.8222	1.02888
Costs.saving.q5	44	.00	5.00	4.2727	.92419
Sale.volume.q5	44	.00	5.00	3.7955	.95429
Material.usage.q5	42	.00	5.00	3.8810	1.08656
Energy.consumption.q5	42	.00	5.00	3.8095	1.13133
Pollution.control.q5	42	.00	5.00	3.6667	1.11894
Work.safety.and.labour.health.q5	40	.00	5.00	3.9250	1.02250
Employee.satisfaction.q5	40	.00	5.00	3.8750	.99195
Community.support.q5	40	.00	5.00	3.2500	1.08012
Market.share.q6	45	.00	5.00	3.0000	1.33144
Costs.saving.q6	44	.00	5.00	3.5682	1.50035
Sale.volume.q6	44	.00	5.00	2.8864	1.31566
Material.usage.q6	42	.00	5.00	3.1429	1.49097
Energy.consumption.q6	42	.00	5.00	3.6190	1.63726
Pollution.control.q6	42	.00	5.00	3.4762	1.61151
Work.safety.and.labour.health.q6	40	.00	5.00	3.1250	1.41761

Employee.satisfaction.q6	40	.00	5.00	3.1500	1.40603
Community.support.q6	40	.00	5.00	3.0000	1.39596
Market.share.q7	45	.00	5.00	3.4222	.96505
Costs.saving.q7	44	2.00	5.00	4.1136	.68932
Sale.volume.q7	44	.00	5.00	3.2727	.89867
Material.usage.q7	42	.00	5.00	4.0952	.95788
Energy.consumption.q7	42	.00	5.00	3.6429	1.07797
Pollution.control.q7	42	.00	5.00	3.9524	1.05812
Work.safety.and.labour.health.q7	40	.00	5.00	3.4500	1.01147
Employee.satisfaction.q7	40	.00	5.00	3.6000	.98189
Community.supportq7	40	.00	5.00	3.7750	1.29075
Market.share.q8	45	.00	5.00	3.1778	1.26651
Costs.saving.q8	44	.00	5.00	3.6591	1.19967
Sale.volume.q8	44	.00	5.00	3.0227	1.19083
Material.usage.q8	42	.00	5.00	3.9524	1.12515
Energy.consumption.q8	42	.00	5.00	3.5000	1.06496
Pollution.control.q8	42	.00	5.00	3.8571	1.18056
Work.safety.and.labour.health.q8	40	.00	5.00	3.0500	1.10824
Employee.satisfaction.q8	40	.00	5.00	3.3000	1.24447
Community.support.q8	40	.00	5.00	3.6000	1.33589

4. Distribution

	N	Minimum	Maximum	Mean	Std. Deviation
Market.share.q1	29	.00	5.00	3.0690	1.16285
Costs.saving.q1	29	.00	5.00	3.5517	1.42894
Sale.volume.q1	29	.00	5.00	2.9655	1.14900
Material.usage.q1	26	.00	5.00	3.4231	1.06482
Energy.consumption.q1	26	.00	5.00	3.5385	1.36325
Pollution.control.q1	26	.00	5.00	4.1538	1.15559

Work.safety.and.labour.health.q1	24	.00	4.00	3.2500	1.07339
Employee.satisfaction.q1	24	.00	5.00	3.3333	1.09014
Community.support.q1	24	.00	5.00	3.6250	1.17260
Market.share.q2	29	.00	5.00	3.2069	1.08164
Costs.saving.q2	29	.00	5.00	3.9655	1.20957
Sale.volume.q2	29	.00	5.00	3.3103	1.16813
Material.usage.q2	26	.00	5.00	3.6154	1.16883
Energy.consumption.q2	26	.00	5.00	4.0000	1.16619
Pollution.control.q2	26	.00	5.00	4.2692	1.15092
Work.safety.and.labour.health.q2	24	1.00	5.00	3.7500	.94409
Employee.satisfaction.q2	24	2.00	5.00	4.2500	.67566
Community.support.q2	24	2.00	5.00	4.0000	.65938
Market.share.q3	29	1.00	5.00	4.0345	.94426
Costs.saving.q3	29	1.00	5.00	4.4138	.94556
Sale.volume.q3	29	1.00	5.00	4.0345	.98135
Material.usage.q3	26	2.00	5.00	4.0000	.89443
Energy.consumption.q3	26	3.00	5.00	4.3462	.74524
Pollution.control.q3	26	.00	5.00	4.1538	1.08415
Work.safety.and.labour.health.q3	24	2.00	5.00	4.1667	.76139
Employee.satisfaction.q3	24	2.00	5.00	4.0833	.71728
Community.support.q3	24	.00	5.00	3.3750	1.05552
Market.share.q4	29	.00	5.00	3.6207	1.26530
Costs.saving.q4	29	.00	5.00	3.4483	1.24172
Sale.volume.q4	29	.00	5.00	3.4483	1.18280
Material.usage.q4	26	.00	5.00	3.3846	1.32897
Energy.consumption.q4	26	.00	5.00	3.3077	1.31967
Pollution.control.q4	26	.00	5.00	3.2692	1.28243
Work.safety.and.labour.health.q4	24	.00	5.00	3.4583	1.14129
Employee.satisfaction.q4	24	.00	5.00	3.2917	1.12208
Community.support.q4	24	.00	5.00	3.4583	1.10253
Market.share.q5	29	.00	5.00	3.8621	1.15648

Costs.saving.q5	29	.00	5.00	4.1379	1.05979
Sale.volume.q5	29	.00	5.00	3.7931	1.08164
Material.usage.q5	26	.00	5.00	3.7692	1.27460
Energy.consumption.q5	26	.00	5.00	3.5769	1.30148
Pollution.control.q5	26	.00	5.00	3.6154	1.29852
Work.safety.and.labour.health.q5	24	.00	5.00	3.7917	1.06237
Employee.satisfaction.q5	24	.00	5.00	3.8333	1.09014
Community.support.q5	24	.00	4.00	3.0417	1.12208
Market.share.q6	29	.00	5.00	3.1034	1.37178
Costs.saving.q6	29	.00	5.00	3.5862	1.45202
Sale.volume.q6	29	.00	5.00	3.1034	1.29131
Material.usage.q6	26	.00	5.00	3.1538	1.54123
Energy.consumption.q6	26	.00	5.00	3.5000	1.65529
Pollution.control.q6	26	.00	5.00	3.4615	1.70249
Work.safety.and.labour.health.q6	24	.00	5.00	3.0417	1.42887
Employee.satisfaction.q6	24	.00	5.00	3.1667	1.37261
Community.support.q6	24	.00	5.00	2.9583	1.33447
Market.share.q7	29	.00	5.00	3.3793	1.08278
Costs.saving.q7	29	2.00	5.00	3.9310	.70361
Sale.volume.q7	29	.00	5.00	3.3448	1.00980
Material.usage.q7	26	.00	5.00	4.0000	1.09545
Energy.consumption.q7	26	.00	5.00	3.5385	1.13950
Pollution.control.q7	26	.00	5.00	3.8077	1.16685
Work.safety.and.labour.health.q7	24	2.00	5.00	3.5000	.88465
Employee.satisfaction.q7	24	2.00	5.00	3.7500	.84699
Community.supportq7	24	.00	5.00	3.6667	1.23945
Market.share.q8	29	.00	5.00	3.2414	1.40548
Costs.saving.q8	29	.00	5.00	3.7931	1.11417
Sale.volume.q8	29	.00	5.00	3.1724	1.33815
Material.usage.q8	26	.00	5.00	4.0000	1.20000
Energy.consumption.q8	26	.00	5.00	3.6154	1.13409

Pollution.control.q8	26	.00	5.00	3.8077	1.26552
Work.safety.and.labour.health.q8	24	.00	5.00	3.0833	1.05981
Employee.satisfaction.q8	24	.00	5.00	3.2917	1.30148
Community.support.q8	24	.00	5.00	3.4167	1.34864
Valid N (listwise)	24				

5. Project and consultancy services

	N	Minimum	Maximum	Mean	Std. Deviation
Market.share.q1	35	.00	5.00	2.8286	1.22440
Costs.saving.q1	35	.00	5.00	3.3714	1.41600
Sale.volume.q1	35	.00	5.00	2.6571	1.16171
Material.usage.q1	32	.00	5.00	3.3125	1.17604
Energy.consumption.q1	32	.00	5.00	3.3750	1.47561
Pollution.control.q1	32	.00	5.00	3.9687	1.33161
Work.safety.and.labour.health.q1	32	.00	5.00	3.0938	1.17389
Employee.satisfaction.q1	32	.00	5.00	3.1875	1.14828
Community.support.q1	32	.00	5.00	3.5625	1.26841
Market.share.q2	35	2.00	5.00	3.3714	.87735
Costs.saving.q2	35	2.00	5.00	4.2571	.81684
Sale.volume.q2	35	.00	5.00	3.2857	1.10004
Material.usage.q2	32	2.00	5.00	3.8438	.88388
Energy.consumption.q2	32	2.00	5.00	4.3750	.65991
Pollution.control.q2	32	3.00	5.00	4.5000	.56796
Work.safety.and.labour.health.q2	32	1.00	5.00	3.9062	.81752
Employee.satisfaction.q2	32	4.00	5.00	4.3750	.49187
Community.support.q2	32	3.00	5.00	4.2187	.55267
Market.share.q3	35	1.00	5.00	4.0857	.78108
Costs.saving.q3	35	1.00	5.00	4.4857	.78108

Sale.volume.q3	35	1.00	5.00	4.0857	.81787
Material.usage.q3	32	2.00	5.00	4.0938	.81752
Energy.consumption.q3	32	3.00	5.00	4.4688	.62136
Pollution.control.q3	32	3.00	5.00	4.3750	.60907
Work.safety.and.labour.health.q3	32	3.00	5.00	4.1875	.59229
Employee.satisfaction.q3	32	3.00	5.00	4.1562	.57414
Community.support.q3	32	.00	5.00	3.6562	1.03517
Market.share.q4	35	.00	5.00	3.7714	1.16533
Costs.saving.q4	35	.00	5.00	3.4000	1.09006
Sale.volume.q4	35	.00	5.00	3.5429	1.06668
Material.usage.q4	32	.00	5.00	3.6250	1.07012
Energy.consumption.q4	32	.00	5.00	3.6250	1.12880
Pollution.control.q4	32	.00	5.00	3.5000	1.10716
Work.safety.and.labour.health.q4	32	.00	5.00	3.5312	1.24394
Employee.satisfaction.q4	32	.00	5.00	3.3438	1.26004
Community.support.q4	32	.00	5.00	3.5312	1.31944
Market.share.q5	35	.00	5.00	3.8000	1.07922
Costs.saving.q5	35	.00	5.00	4.1429	.94380
Sale.volume.q5	35	.00	5.00	3.7714	.97274
Material.usage.q5	32	.00	5.00	3.8125	1.17604
Energy.consumption.q5	32	.00	5.00	3.8438	1.01947
Pollution.control.q5	32	.00	5.00	3.6875	.99798
Work.safety.and.labour.health.q5	32	.00	5.00	4.0312	.96668
Employee.satisfaction.q5	32	.00	5.00	4.0000	.98374
Community.support.q5	32	.00	5.00	3.3750	1.15703
Market.share.q6	35	.00	5.00	3.0286	1.20014
Costs.saving.q6	35	.00	5.00	3.6857	1.34539
Sale.volume.q6	35	.00	5.00	3.0571	1.10992
Material.usage.q6	32	.00	5.00	3.1875	1.57475
Energy.consumption.q6	32	.00	5.00	3.7188	1.54991
Pollution.control.q6	32	.00	5.00	3.5000	1.68485

Work.safety.and.labour.health.q6	32	.00	5.00	3.2812	1.48616
Employee.satisfaction.q6	32	.00	5.00	3.2500	1.45912
Community.support.q6	32	.00	5.00	3.1563	1.46154
Market.share.q7	35	2.00	5.00	3.4857	.85307
Costs.saving.q7	35	3.00	5.00	4.0571	.59125
Sale.volume.q7	35	2.00	5.00	3.3143	.75815
Material.usage.q7	32	3.00	5.00	4.0625	.66901
Energy.consumption.q7	32	2.00	5.00	3.5625	.91361
Pollution.control.q7	32	2.00	5.00	3.9688	.89747
Work.safety.and.labour.health.q7	32	.00	5.00	3.5000	1.07763
Employee.satisfaction.q7	32	.00	5.00	3.7187	1.05446
Community.supportq7	32	.00	5.00	3.7812	1.36155
Market.share.q8	35	.00	5.00	3.1143	1.25491
Costs.saving.q8	35	.00	5.00	3.5429	1.19663
Sale.volume.q8	35	.00	5.00	3.0000	1.16316
Material.usage.q8	32	2.00	5.00	4.0625	.87759
Energy.consumption.q8	32	2.00	5.00	3.5000	.91581
Pollution.control.q8	32	2.00	5.00	3.9375	1.01401
Work.safety.and.labour.health.q8	32	.00	5.00	3.0625	1.16224
Employee.satisfaction.q8	32	.00	5.00	3.2813	1.34966
Community.support.q8	32	.00	5.00	3.5312	1.41386
Valid N (listwise)	32				

Appendix J: ANOVA tests

ANOVA Results: The effect of respondents' position on environmentally-friendly energy sources

ANOVA

Performance measures		Sum of Squares	df	Mean Square	F	Sig.
Market share	Between Groups	10.002	5	2.000	1.146	.345
	Within Groups	116.956	67	1.746		
	Total	126.959	72			
Costs saving	Between Groups	9.525	5	1.905	.870	.506
	Within Groups	148.921	68	2.190		
	Total	158.446	73			
Sale volume	Between Groups	8.368	5	1.674	1.013	.417
	Within Groups	110.646	67	1.651		
	Total	119.014	72			
Material usage	Between Groups	8.302	5	1.660	1.060	.391
	Within Groups	100.284	64	1.567		
	Total	108.586	69			
Energy consumption	Between Groups	10.055	5	2.011	.965	.446
	Within Groups	133.387	64	2.084		
	Total	143.443	69			
Pollution control	Between Groups	6.026	5	1.205	.760	.582
	Within Groups	101.459	64	1.585		
	Total	107.486	69			
Work safety and labour health	Between Groups	8.586	5	1.717	1.130	.354
	Within Groups	91.187	60	1.520		
	Total	99.773	65			
Employee satisfaction	Between Groups	5.727	5	1.145	.957	.451
	Within Groups	71.803	60	1.197		
	Total	77.530	65			
Community support	Between Groups	7.288	5	1.458	1.089	.376
	Within Groups	80.303	60	1.338		
	Total	87.591	65			

ANOVA Results: The effect of respondents' position on replacing old vehicles

ANOVA

Performance measures		Sum of Squares	df	Mean Square	F	Sig.
Market share	Between Groups	9.062	5	1.812	1.158	.339
	Within Groups	104.828	67	1.565		
	Total	113.890	72			
Costs saving	Between Groups	4.496	5	.899	.547	.740
	Within Groups	111.842	68	1.645		
	Total	116.338	73			
Sale volume	Between Groups	11.428	5	2.286	1.326	.264
	Within Groups	115.449	67	1.723		
	Total	126.877	72			
Material usage	Between Groups	12.803	5	2.561	1.714	.144
	Within Groups	97.085	65	1.494		
	Total	109.887	70			
Energy consumption	Between Groups	6.924	5	1.385	.952	.454
	Within Groups	94.569	65	1.455		
	Total	101.493	70			
Pollution control	Between Groups	7.786	5	1.557	1.124	.357
	Within Groups	90.045	65	1.385		
	Total	97.831	70			
Work safety and labour health	Between Groups	1.042	5	.208	.155	.978
	Within Groups	82.122	61	1.346		
	Total	83.164	66			
Employee satisfaction	Between Groups	3.696	5	.739	.854	.517
	Within Groups	52.782	61	.865		
	Total	56.478	66			
Community support	Between Groups	5.134	5	1.027	1.030	.408
	Within Groups	60.806	61	.997		
	Total	65.940	66			

ANOVA Results: The effect of respondents' position on Optimisation the distribution process

ANOVA

Performance measures		Sum of Squares	df	Mean Square	F	Sig.
Market share	Between Groups	12.566	5	2.513	1.940	.099
	Within Groups	88.096	68	1.296		
	Total	100.662	73			
Costs saving	Between Groups	6.583	5	1.317	1.408	.232
	Within Groups	63.579	68	.935		
	Total	70.162	73			
Sale volume	Between Groups	12.398	5	2.480	2.261	.058
	Within Groups	74.589	68	1.097		
	Total	86.986	73			
Material usage	Between Groups	6.572	5	1.314	1.374	.246
	Within Groups	61.200	64	.956		
	Total	67.771	69			
Energy consumption	Between Groups	3.832	5	.766	.845	.523
	Within Groups	58.011	64	.906		
	Total	61.843	69			
Pollution control	Between Groups	7.146	5	1.429	1.054	.394
	Within Groups	86.797	64	1.356		
	Total	93.943	69			
Work safety and labour health	Between Groups	13.379	5	2.676	4.771	.001
	Within Groups	33.651	60	.561		
	Total	47.030	65			
Employee satisfaction	Between Groups	14.567	5	2.913	6.262	.000
	Within Groups	27.917	60	.465		
	Total	42.485	65			
Community support	Between Groups	5.768	5	1.154	.857	.515
	Within Groups	80.717	60	1.345		
	Total	86.485	65			

ANOVA Results: The effect of respondents' position on environmental management system

ANOVA

Performance measures		Sum of Squares	df	Mean Square	F	Sig.
Market share	Between Groups	10.701	5	2.140	1.402	.235
	Within Groups	103.786	68	1.526		
	Total	114.486	73			
Costs saving	Between Groups	9.571	5	1.914	1.399	.236
	Within Groups	91.689	67	1.368		
	Total	101.260	72			
Sale volume	Between Groups	13.005	5	2.601	2.033	.085
	Within Groups	85.735	67	1.280		
	Total	98.740	72			
Material.usage	Between Groups	5.395	5	1.079	.681	.639
	Within Groups	99.822	63	1.584		
	Total	105.217	68			
Energy consumption	Between Groups	6.849	5	1.370	.880	.500
	Within Groups	98.108	63	1.557		
	Total	104.957	68			
Pollution control	Between Groups	13.946	5	2.789	1.770	.132
	Within Groups	99.300	63	1.576		
	Total	113.246	68			
Work safety and labour health	Between Groups	12.046	5	2.409	1.500	.203
	Within Groups	96.393	60	1.607		
	Total	108.439	65			
Employee satisfaction	Between Groups	9.362	5	1.872	1.167	.336
	Within Groups	96.229	60	1.604		
	Total	105.591	65			
Community support	Between Groups	12.767	5	2.553	1.397	.238
	Within Groups	109.673	60	1.828		
	Total	122.439	65			

ANOVA Results: The effect of respondents' position on efficient storage

ANOVA

Performance measures		Sum of Squares	df	Mean Square	F	Sig.
Market share	Between Groups	12.138	5	2.428	1.909	.104
	Within Groups	86.456	68	1.271		
	Total	98.595	73			
Costs saving	Between Groups	6.033	5	1.207	1.119	.359
	Within Groups	73.318	68	1.078		
	Total	79.351	73			
Sale.volume	Between Groups	7.869	5	1.574	1.397	.237
	Within Groups	75.501	67	1.127		
	Total	83.370	72			
Material usage	Between Groups	9.228	5	1.846	1.185	.326
	Within Groups	99.644	64	1.557		
	Total	108.871	69			
Energy consumption	Between Groups	7.592	5	1.518	.918	.475
	Within Groups	105.851	64	1.654		
	Total	113.443	69			
Pollution control	Between Groups	6.445	5	1.289	.803	.551
	Within Groups	102.697	64	1.605		
	Total	109.143	69			
Work safety and labour health	Between Groups	14.692	5	2.938	2.411	.047
	Within Groups	73.127	60	1.219		
	Total	87.818	65			
Employee satisfaction	Between Groups	9.356	5	1.871	1.659	.158
	Within Groups	67.674	60	1.128		
	Total	77.030	65			
Community support	Between Groups	11.416	5	2.283	1.577	.180
	Within Groups	86.842	60	1.447		
	Total	98.258	65			

ANOVA Results: The effect of respondents' position on energy efficient refrigerants

ANOVA

Performance measures		Sum of Squares	df	Mean Square	F	Sig.
Market share	Between Groups	20.391	5	4.078	1.975	.094
	Within Groups	138.349	67	2.065		
	Total	158.740	72			
Costs saving	Between Groups	10.201	5	2.040	.743	.594
	Within Groups	183.909	67	2.745		
	Total	194.110	72			
Sale volume	Between Groups	8.647	5	1.729	.824	.537
	Within Groups	138.464	66	2.098		
	Total	147.111	71			
Material usage	Between Groups	8.441	5	1.688	.608	.694
	Within Groups	174.863	63	2.776		
	Total	183.304	68			
Energy consumption	Between Groups	9.857	5	1.971	.567	.725
	Within Groups	222.485	64	3.476		
	Total	232.343	69			
Pollution control	Between Groups	10.634	5	2.127	.645	.667
	Within Groups	211.152	64	3.299		
	Total	221.786	69			
Work safety and labour health	Between Groups	18.565	5	3.713	1.534	.193
	Within Groups	145.193	60	2.420		
	Total	163.758	65			
Employee satisfaction	Between Groups	14.941	5	2.988	1.234	.305
	Within Groups	145.317	60	2.422		
	Total	160.258	65			
Community support	Between Groups	13.085	5	2.617	1.030	.409
	Within Groups	152.506	60	2.542		
	Total	165.591	65			

ANOVA Results: The effect of respondents' position on waste control

ANOVA

Performance measures		Sum of Squares	df	Mean Square	F	Sig.
Market share	Between Groups	18.153	5	3.631	2.644	.030
	Within Groups	93.360	68	1.373		
	Total	111.514	73			
Costs saving	Between Groups	10.758	5	2.152	1.482	.207
	Within Groups	97.269	67	1.452		
	Total	108.027	72			
Sale volume	Between Groups	12.928	5	2.586	1.956	.097
	Within Groups	88.579	67	1.322		
	Total	101.507	72			
Material usage	Between Groups	13.177	5	2.635	1.876	.111
	Within Groups	89.909	64	1.405		
	Total	103.086	69			
Energy consumption	Between Groups	10.286	5	2.057	1.229	.306
	Within Groups	107.086	64	1.673		
	Total	117.371	69			
Pollution control	Between Groups	15.878	5	3.176	2.308	.054
	Within Groups	88.065	64	1.376		
	Total	103.943	69			
Work safety and labour health	Between Groups	9.056	5	1.811	1.612	.171
	Within Groups	67.429	60	1.124		
	Total	76.485	65			
Employee satisfaction	Between Groups	3.982	5	.796	.645	.667
	Within Groups	74.139	60	1.236		
	Total	78.121	65			
Community support	Between Groups	9.144	5	1.829	1.201	.320
	Within Groups	91.341	60	1.522		
	Total	100.485	65			

ANOVA Results: The effect of respondents' position on recycling packaging material

ANOVA

Performance measures		Sum of Squares	df	Mean Square	F	Sig.
Market share	Between Groups	12.220	5	2.444	1.515	.196
	Within Groups	111.300	69	1.613		
	Total	123.520	74			
Costs saving	Between Groups	6.582	5	1.316	1.045	.398
	Within Groups	85.635	68	1.259		
	Total	92.216	73			
Sale volume	Between Groups	13.455	5	2.691	2.057	.082
	Within Groups	87.668	67	1.308		
	Total	101.123	72			
Material usage	Between Groups	16.232	5	3.246	2.106	.076
	Within Groups	98.640	64	1.541		
	Total	114.871	69			
Energy consumption	Between Groups	12.097	5	2.419	1.672	.154
	Within Groups	92.603	64	1.447		
	Total	104.700	69			
Pollution control	Between Groups	12.742	5	2.548	1.560	.184
	Within Groups	104.529	64	1.633		
	Total	117.271	69			
Work safety and labour health	Between Groups	6.545	5	1.309	.801	.553
	Within Groups	98.076	60	1.635		
	Total	104.621	65			
Employee satisfaction	Between Groups	9.327	5	1.865	1.163	.338
	Within Groups	96.203	60	1.603		
	Total	105.530	65			
Community support	Between Groups	8.178	5	1.636	.875	.503
	Within Groups	112.140	60	1.869		
	Total	120.318	65			

ANOVA result: The effect of respondents' position on influencing factors

Performance measures		Sum of Squares	df	Mean Square	F	Sig.
Employee interest	Between Groups	7.069	5	1.414	1.814	.125
	Within Groups	42.865	55	.779		
	Total	49.934	60			
Tech Accumulation	Between Groups	2.544	5	.509	.608	.694
	Within Groups	46.014	55	.837		
	Total	48.557	60			
Supplier pressure	Between Groups	24.296	5	4.859	3.865	.005
	Within Groups	67.888	54	1.257		
	Total	92.183	59			
Customer pressure	Between Groups	5.627	5	1.125	.984	.436
	Within Groups	62.930	55	1.144		
	Total	68.557	60			
Competitor pressure	Between Groups	12.065	5	2.413	2.202	.067
	Within Groups	59.185	54	1.096		
	Total	71.250	59			
Government pressure	Between Groups	4.482	5	.896	.849	.521
	Within Groups	58.075	55	1.056		
	Total	62.557	60			
Company size	Between Groups	7.552	5	1.510	1.371	.250
	Within Groups	58.380	53	1.102		
	Total	65.932	58			
Governmental Regulation	Between Groups	6.341	5	1.268	1.197	.323
	Within Groups	58.249	55	1.059		
	Total	64.590	60			
Environmental demand	Between Groups	9.390	5	1.878	1.234	.306
	Within Groups	83.692	55	1.522		
	Total	93.082	60			
Social awareness	Between Groups	6.508	5	1.302	1.288	.282
	Within Groups	55.558	55	1.010		
	Total	62.066	60			
Fuel and energy prices	Between Groups	4.038	5	.808	.749	.590
	Within Groups	59.273	55	1.078		
	Total	63.311	60			
Potential for achieving a competitive advantage	Between Groups	.797	5	.159	.115	.988
	Within Groups	75.957	55	1.381		
	Total	76.754	60			

Appendix K: Means tests of influencing factors

Means of influencing factors dividing based on logistics services

1. Means based on freight forwarding

Influencing factors	N	Minimum	Maximum	Mean	Std. Deviation
Employee interest	46	1.00	5.00	3.0435	.81531
Accumulation of technology	46	1.00	5.00	3.4130	.93276
Supplier pressure	45	.00	5.00	2.8444	1.26051
Customer pressure	46	1.00	5.00	3.6304	1.04048
Competitor pressure	45	1.00	5.00	3.2444	1.11101
Government pressure	46	1.00	5.00	3.5870	1.06617
Company size	44	.00	5.00	3.0000	1.05654
Governmental Regulation	46	.00	5.00	3.8696	1.10772
Environmental demand	46	.00	5.00	3.2609	1.32388
Social awareness	46	1.00	5.00	3.4565	1.00458
Increasing in fuel and energy prices	46	1.00	5.00	3.8043	1.02458
Potential for competitive advantage	46	.00	5.00	3.6087	1.14462

2. Means based on packaging and labelling

Influencing factors	N	Minimum	Maximum	Mean	Std. Deviation
Employee interest	19	2.00	4.00	3.2105	.63060
Accumulation of technology	19	2.00	5.00	3.6316	.76089
Supplier pressure	18	.00	5.00	2.7222	1.36363
Customer pressure	19	3.00	5.00	4.1053	.73747
Competitor pressure	19	1.00	5.00	3.4211	.96124
Government pressure	19	3.00	5.00	3.8421	.76472
Company size	18	1.00	5.00	3.2222	1.00326
Governmental Regulation	19	.00	5.00	4.0526	1.22355
Environmental demand	19	1.00	5.00	3.6842	1.10818
Social awareness	19	1.00	5.00	3.5789	.96124
Increasing in fuel and energy prices	19	2.00	5.00	4.1579	.89834
Potential for competitive advantage	19	.00	5.00	3.6842	1.15723

3. Means based on storage and warehousing

Influencing factors	N	Minimum	Maximum	Mean	Std. Deviation
Employee interest	43	1.00	5.00	3.0698	.85622
Accumulation of technology	43	1.00	5.00	3.4186	.82325

Supplier pressure	42	.00	5.00	2.7857	1.25980
Customer pressure	43	1.00	5.00	3.6977	.93948
Competitor pressure	43	1.00	5.00	3.2326	1.08753
Government pressure	43	1.00	5.00	3.6047	.95468
Company size	41	1.00	5.00	2.9756	1.01212
Governmental Regulation	43	.00	5.00	3.8372	1.02191
Environmental demand	43	.00	5.00	3.3488	1.25136
Social awareness	43	1.00	5.00	3.3488	1.02082
Increasing in fuel and energy prices	43	1.00	5.00	3.8605	.98998
Potential for competitive advantage	43	.00	5.00	3.6279	1.13438

4. Means based on distribution

Influencing factors	N	Minimum	Maximum	Mean	Std. Deviation
Employee interest	45	1.00	5.00	2.9778	.86573
Accumulation of technology	45	1.00	5.00	3.3556	.90843
Supplier pressure	44	.00	5.00	2.6136	1.31566
Customer pressure	45	1.00	5.00	3.6222	1.09314
Competitor pressure	45	1.00	5.00	3.0889	1.14460
Government pressure	45	1.00	5.00	3.5556	1.05649
Company size	43	.00	5.00	2.9070	1.10871
Governmental Regulation	45	.00	5.00	3.9111	1.06221
Environmental demand	45	.00	5.00	3.2667	1.28629
Social awareness	45	1.00	5.00	3.2889	1.03621
Increasing in fuel and energy prices	45	1.00	5.00	3.8444	1.04350
Potential for competitive advantage	45	.00	5.00	3.5556	1.15907
Valid N (listwise)	43				

5. Means based on project and consultancy services

Influencing factors	N	Minimum	Maximum	Mean	Std. Deviation
Employee interest	25	1.00	5.00	3.0800	.90921
Accumulation of technology	25	2.00	5.00	3.6400	.86023
Supplier pressure	24	1.00	5.00	2.9167	1.10007
Customer pressure	25	2.00	5.00	3.7600	.92556
Competitor pressure	24	1.00	5.00	3.3750	1.05552
Government pressure	25	1.00	5.00	3.5600	1.00333
Company size	24	1.00	5.00	2.7500	1.07339
Governmental Regulation	25	.00	5.00	3.9600	1.20692
Environmental demand	25	1.00	5.00	3.3600	1.18603
Social awareness	25	1.00	5.00	3.3600	.99499
Increasing in fuel and energy prices	25	1.00	5.00	3.8800	1.01325
Potential for competitive advantage	25	.00	5.00	3.5200	1.15902

Appendix L: Demographic tests

position

	positions	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	9	14.7	14.7	14.7
	1	3	4.9	4.9	19.6
	2	10	16.4	16.4	36.0
	3	12	19.8	19.8	55.8
	4	14	22.9	22.9	78.7
	5	13	21.3	21.3	100.0
	Total	61	100.0	100.0	

Years of experience

Years		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	15	24.9	24.9	24.9
	2	18	28.7	28.7	53.6
	3	16	26.1	26.1	79.7
	4	12	20.3	20.3	100.0
	Total	61	100.0	100.0	

Freight transportation

Services		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	48	78.6	100.0	100.0
Missing	System	13	21.4		
Total		61	100.0		

Packaging and labelling

Services		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	19	31.1	100.0	100.0
Missing	System	42	68.8		
Total		61	100.0		

Warehousing

Services		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	45	73.7	100.0	100.0
Missing	System	16	26.3		
Total		61	100.0		

Distribution

Services		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	45	73.7	100.0	100.0
Missing	System	16	26.3		
Total		61	100.0		

Consultancy and Projects

Services		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	27	44.2	100.0	100.0
Missing	System	34	55.8		
Total		61	100.0		

The number of Employee

Employee		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	4.9	4.9	4.9
	2	9	14.8	14.8	19.7
	3	7	11.7	11.7	31.4
	4	4	6.5	6.5	37.9
	5	2	3.2	3.2	41.1
	6	2	3.2	3.2	44.3
	7	34	55.7	55.7	100.0
	Total	61	100.0	100.0	

Annual revenue

	Revenue	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	4.9	4.9	4.9
	2	5	8.9	8.9	13.8
	3	6	9.9	9.9	23.7
	4	33	54.0	54.0	77.7
	5	14	22.3	22.3	100.0
	Total	61	100.0	100.0	

Energy sources

Energy sources

	Sources	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	5	8.8	8.8	8.8
	1	1	1.3	1.3	10.1
	2	34	55.8	55.8	65.9
	4	21	34.1	34.1	100.0
	Total	61	100.0	100.0	

Appendix M: AHP results

AHP results from Expert Choice Software

Eigenvectors of sustainability dimensions matrix

Eigenvectors of economic matrix

Eigenvectors of environmental matrix

Eigenvectors of social matrix

Appendix N: Definitions of sustainable performance measures

Sustainable performance measure	Definition	Author
Market share (economic)	The percentage of an industry, or a market's total sales, that is earned by a company over a specified time period	(Ferrier, Smith & Grimm 1999; Fowlie, Reguant & Ryan 2016; Huang, Jain & Kini 2019)
Costs savings (economic)	A reduction in expenses, especially in business	(Kramer et al. 2019; Laborde et al. 2017; Riley & Kleist 2005)
Sale volume (economic)	The number of units sold within a reporting period	(McGettigan et al. 2019; Rogers et al. 2019; Stewart 2019)
Pollution control (environmental)	The process of reducing or eliminating the release of pollutants into the environment.	(Eljarrat & Barceló 2018; Li et al. 2016)
Energy consumption (environmental)	The total amount of energy or power used.	(De Cian & Wing 2019; Ozcan & Ozturk 2019)
Material usage (environmental)	The difference between the standard quantity of materials that should have been used for the number of units actually produced, and the actual quantity of materials used, valued at the standard cost per unit of material.	(Huang et al. 2019; Rogetzer, Silbermayr & Jammernegg 2019)
Worker safety and labour health (social)	Employer's duties to prevent workplace injuries and ill-health the employers by providing and maintaining a safe workplace which uses safe plant and equipment. Prevent any improper conduct or behaviour likely to put	(Hakro & Jinshan 2019; Ryan et al. 2018)

	the safety, health and welfare of employees at risk.	
Employee satisfaction (social)	The term used to describe whether employees are happy and fulfilling their desires and needs at work.	(Gul et al. 2018; Phuong & Khuong 2018)
Community support (social)	Supporting a local non-profit group, social enterprise or interested charity	(Defourny & Nyssens 2017; Estrin, Mickiewicz & Stephan 2016)